U. S. ARMY MATERIEL COMMAND

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HANDBOOK OF FOREIGN EXPLOSIVES

U S ARMY
FOREIGN SCIENCE
AND
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HANDBOOK OF FOREIGN EXPLOSIVES

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ABSTRACT

(U) This Handbook of Foreign Explosives contains technical information and reference data on the chemical and physical characteristics, known variations in nomenclature, and the application of explosive compounds to the various types of ammunition in use by selected countries.

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HANDBOOK OF FOREIGN EXPLOSIVES

Section I. INTRODUCTION

1. PURPOSE

The purpose of this handbook is to provide research and development personnel, explosive ordnance disposal specialists, military personnel, and members of the intelligence community with a single source of technical information and data on explosives of selected foreign countries.

2. SCOPE

a. Priority of coverage has been given to explosives of the U.S.S.R. and Western countries with the potential to develop and produce explosives. The handbook identifies explosives which were standard in World War II as well as those which may be in current use. The information in the handbook is intended solely for use as a reference and an identification guide and not as an assessment of the quality of the material or as a comparison with similar compositions of U.S. origin.

b. This handbook is divided into a General Index and a Country Index. The General Index lists explosives in alphabetical order; it defines each explosive briefly and discusses at some length those common to several countries. In detailing characteristics, explosive power and other test results are expressed in relation to the power of an equal weight of TNT; thus, "Explosive E power equals 1.35" means that Explosive E is 1.35 times as powerful as TNT. When pertinent, the General Index gives the foreign nomenclature for explosives and makes specific reference to the Country Index for additional information on particular explosive compounds.

c. The Country Index is arranged alphabetically by country. Under each country are the following:

(1) Introductory remarks about the explosives industry.

(2) An alphabetical list of explosives, with information on manufacture, composistion, and use.

(3) Resumes of unusual research and development in explosives.

(4) A list of pertinent references.

3. SUMMARY

a. The explosives in general use by the Soviet Union and the free world are of either similar or well-known composition.

b. Although a wide variety of explosive compositions is employed by different countries, essentially all utilize standard basic ingredients, such as ammonium nitrate, nitroglycerin, TNT, and tetryl. The nature and composition of the material are largely determined by its intended application. The combination of ingredients, percent composition, and widely diversified nomenclature are found to be the main variants from country to country. The explosives vary from highly complex and efficient compounds to crude and relatively ineffective mixtures used in guerrilla and partisan operations.

c. Major foreign research and development efforts in the field of explosives are directed toward understanding the basic mechanism and theory of combustion and detonation, and the more efficient combination and utilization of known compounds. A breakthrough in understanding these fundamental processes would result in rapid advances in explosive technology.

A or AT

Soviet abbreviation for Amatol.

A-IX-2 (bursting charge)

A Soviet high-explosive bursting charge for Projectiles. There is no corresponding US composition. See under Soviet Explosives.

ABEL POWDER or PICRIC POWDER (booster charge)

A British booster explosive charge. There is no corresponding US composition. The French used a similar composition called Brugère Poudre. See under French Explosives.

ABONACHIT 2 or FÜLLPULVER Nr 57 (bursting charge)

A German Ammonium Nitrate Explosive used as a bursting charge in Hand Grenades. There is no corresponding US composition. See Füllpulver Nr 57 under German Explosives.

ACEITE EXPLOSIVO

Spanish for Nitroglycerin. See Nitroglicerina under Spanish Explosives.

ÁCIDA de PLOMO

Spanish for Lead Azide.

ACIDE PICRIQUE

French for Picric Acid.

ACIDO d'ARGENTO

Italian for Silver Azide.

ACIDO di PIOMBO

Italian for Lead Azide.

ACIDO PICRICO

Italian for Picric Acid.

ÁCIDO PÍCRICO.

Spanish for Picric Acid. See Picrinita under Spanish Explosives.

ACIDO STIFNICO or TRINITRORESORCINA

Italian for Styphnic Acid.

AFOCITE (blasting explosive)

An Italian Ammonium Nitrate blasting explosive. There is no corresponding US composition. See under Italian Explosives.

A(KO), Type A Explosive or OTSU-B (bursting charge)

A Japanese burster charge. There is no corresponding US composition. This explosive is the same as that called Schiesswolle 18 or Code Names NTD_2 & TSMV 1-101 by the Germans. See under German Explosives and under Japanese Explosives.

ALBIT (blasting explosive)

A German blasting explosive. There is no corresponding US composition. See under German Explosives.

ALBITE (bursting charge)

An Italian explosive filler for projectiles. There is no corresponding US composition. See under Italian Explosives.

ALDORFIT (permissible blasting explosive)

A commercial explosive developed and manufactured in Switzerland but used extensively in Germany. The composition is similar to AMMONITE (qv). See Aldorfit under German Explosives & under Swiss Explosives.

ALGODÓN FULMINANTE or ALGODÓN PÓLVORA

Spanish for Guncotton.

ALKALITE (permissible mining explosive)

A commercial explosive developed and manufactured in Belgium. There is no corresponding US composition. See under Belgian Explosives.

ALKALSIT (blasting explosive)

A German Cheddite-type explosive developed before WW II. There is no corresponding US composition. See under German Explosives.

ALMATRIT (blasting explosive)

Commercial explosives developed in the USSR. There are no corresponding US explosives. See under Soviet Explosives.

ALSILITE (mining explosive)

A Belgian commercial explosive developed and manufactured in Belgium. This composition contains the same ingredients as Ammonal. See under Belgian Explosives.

ALUMATOL (military & blasting explosive)

A British explosive of the Ammonal type. There is no corresponding US explosive, but Ammonals contain the same ingredients.

ALUMIT (military & blasting explosive)

A Soviet explosive of the Ammonal type. There is no corresponding US explosive but Ammonals contain the same ingredients. See under Soviet Explosives.

AMATEX (bomb filler)

A British high-explosive bomb filler. There are no corresponding US explosives. A different composition by the same name is described under Spanish Explosives. See Amatex under Spanish Explosives.

AMATOL (bursting charge)

a) Foreign Nomenclature:

Britain:	Amatol
France:	Amatol & Explosif du type N n° 0
Germany:	Amatol & Füllpulver (Fp)
Italy:	Amatolo
Japan:	Shōtoyaku
Soviet Union:	Amatol & A or AT
Spain:	Amatolo & Nitramita Española

b) Origin:

Invented in 1915 by the British as mixtures of Ammonium Nitrate and TNT in order to extend the available supply of TNT which was very scarce at that time.

c) Identifying Features:

Color is white to light buff. But due to the presence of impurities or exposure to light and moisture, it darkens to a dark brown color. It can be distinguished by its grainy, brown sugar appearance.

d) Chemical Composition:

Amatols are mechanical mixtures of Ammonium Nitrate 80 to 40% & TNT 20 to 60%. The most common composition contains these ingredients in 50/50 proportions. Other compositions contain Ammonium Nitrate and TNT in 80/20, 60/40, 45/55 and 40/60 ratios. The first figure represents the Ammonium Nitrate content in all compositions.

e) Physical Properties:

Amatols, except 80/20 mixtures, can be heated up to 95°C and cast loaded at densities of 1.54-1.61 gm/cc directly into ammunition end items. Because of their plasticity, mixtures containing 80% Ammonium Nitrate must be press loaded or extruded, at density 1.46 gm/cc, into items.

All Amatols are hygroscopic, mixtures having the higher Ammonium Nitrate content being the more hygroscopic. These mixtures in the presence of moisture attack such metals as copper, brass, bronze & lead; they can form dangerous compounds with copper and its alloys.

f) Test Methods and Explosive Characteristics:

Amatols are subjected to the standard tests used to determine the sensitivity, stability, power & other explosive characteristics of high explosives. See Table 1.

g) Manufacturing Processes:

In preparing Amatols, the Ammonium Nitrate, previously screened to the desired particle size and dried to a moisture content of not more than 0.25%, is heated to 90°C in a steam-jacketed mixing kettle provided with a mechanical agitator. It is gradually added to the calculated amount of molten TNT in another steam-jacketed kettle equipped with mechanical agitation. Heating at 90°C and mixing are continued until thorough blending & uniform fluidity are achieved. The 50/50, 60/40 and 40/60 Amatols can be cast loaded at 85°C. For 80/20 Amatols, addition of the molten TNT to the Ammonium Nitrate, and heating & blending of the ingredients at 95°C are preferred until the mixture is ready for loading by extrusion.

h) Safety Hazards:

The sensitivity of Amatols to initiation by impact or friction is about the same order as that of TNT. Ordinarily, Amatols will not detonate from the impact of a .30 cal rifle bullet at 90 feet. The spontaneous ignition (detonation) temperature of 50/50 Amatol is about 260°C, compared with about 460°C for TNT. Amatols are Class 9, Group I explosives from the standpoint of their class quantity-distance storage, and group according to compatibility in mixed storage.

i) Inspection Procedures:

Determination of the composition of Amatols can be made by extracting a weighed sample with benzene, drying the residue, and weighing. The weight of the residue is calculated as percentage Ammonium Nitrate and the difference from 100 as percentage TNT.

Loaded items of ammunition, stored at elevated temperatures, should be inspected periodically to determine if exudation has occurred. See under Storage below.

j) Preservation and Special Handling Requirements:

To prevent corrosion caused by contact of Amatols with metals, a common practice is to coat the inside walls of the ammunition with acid-proof black paint prior to loading. Another practice to prevent moisture from entering loaded items is to form a seal by pouring molten TNT on top of the Amatol.

k) Storage:

Amatols prepared from high purity ingredients and adequately protected from contact with moisture are not significantly affected by prolonged storage at 50°C. If, on periodic inspection, Amatol-loaded shells are found to be exuding, they should not be issued for service use because these shells may cause premature explosions, when fired, due to set-back. Exuding shells, discarded bombs or scrap Amatol should be destroyed as indicated under Disposal Procedures.

l) Demilitarization and/or Disposal Procedures:

Destruction of Amatol-loaded ammunition, to prevent its use by the enemy, is best accomplished by placing the items in contact in piles and detonating them with an appropriate number of TNT charges, using blasting caps and sufficient safety fuse to permit reaching cover at 200 yards. The amounts of TNT required are one-half pound of TNT per 100 rounds of unpacked ammunition, and 1 pound of TNT per 100 rounds packed in wooden or metal containers.

Bombs can be destroyed in the same manner as for the destruction of shells, but bombs contain much larger quantities of explosive and the number detonated at one time must be small. Protection must be provided to shield personnel from flying fragments or missiles.

Scrap Amatols, Amatol-loaded small bombs or projectiles may be destroyed by burning in beds, or by detonation in accordance with approved procedures, such as described in US Ordnance Safety Field Manual ORDM 7-224.

Large shells & large bombs may have their Amatol charges removed by steaming operations, disposing of the Ammonium Nitrate solution into a stream, or burning of the TNT in beds.

The safest and easiest way to destroy unusable Amatols or Amatol-loaded ammunition is to dump it at sea. Items disposed of in this manner must be dumped not less than 10 miles from shore at depths of not less than 500 fathoms; and they must be of sufficient weight to sink to the ocean floor. Detailed instructions are given in Army SR 75-70-10/AFR 68-3.

m) Uses:

Amatols have been universally used, by all nations, in all types of ammunition as a substitute for TNT. The lower Ammonium Nitrate content Amatols are generally used in smaller ammunition. In larger ammunition the Ammonium Nitrate content can be increased and still maintain a high order detonation mixture. However, the development of more powerful binary mixtures, such as Composition B and Pentolite, and of aluminized mixtures, such as Torpex and HBX, have lessened the need for Amatols.

Amatols are known to be used in Britain, Germany, Italy, Japan, USSR, Spain & USA. For detailed uses of specific compositions by various countries, see under the individual country.

In the United States 50/50 Amatol has been used in Light Case, General Purpose and Semi-Armor-Piercing Bombs; and in some Shells.

60/40 and 80/20 Amatols were used in various kinds of Shells.

65/35 Amatol was used in some Shells & Bombs during the early part of WW II.

The rapid production during WW II of a huge supply of TNT removed the necessity of using Ammonium Nitrate as a substitute for TNT. Another factor contributing to the disuse of Amatols as military explosives was the appearance during WW II of other explosives, such as PETN & RDX and their binary & ternary mixtures, which are more powerful than TNT.

TABLE 1

Explosive Properties of Amatols

Composition & Properties	80/20	60/40	Amatol 50/50	45/55	40/60
Composition:					
Ammonium Nitrate %	80	60	50	45	40
TNT %	20	40	50	55	60
Nitrogen Content, %	31.7	28.4	26.8	25.9	25.1
Oxygen Balance to CO_2, %	+1.20	-17.6	-27.0	-31.7	-36.4
Oxygen Balance to CO, %	+11.06	+2.13	-2.32	-4.55	-6.78
Color	Lt buff	Lt buff	Buff	Buff	Buff
Melting Point, °C	-	-	81	-	-
Density, gm/cc	1.46	1.61	1.59	-	1.54
Detonation Velocity, m/sec	5080*	5500*	5600*	6470	6500
Detonation Velocity, ft/sec	-	-	19,680	-	-
Brisance by Sand Test, assuming 100% for TNT	75	85	86-90	-	95
Explosion Temperature, °C	280-300	270	254-265	-	-
Heat of Explosion, cal/g at C_v	1004	-	950	-	920
Heat Tests	Slightly less stable than TNT				
Impact Sensitivity Test, 2kg wt, assuming 100 cm fall for TNT	90-95	95-100	93-100	-	93-100
Pendulum Friction Test		Unaffected			
Power (by Ballistic Mortar Test or by Trauzl Test), assuming 100% for TNT	130	128	120-125	-	120
Power by Trauzl Test, assuming 100% for PA	-	-	-	112	-
Rifle Bullet Test		Unaffected			
Energy of Air Blast %	-	-	84	-	-
Energy of Shock in water %	-	-	94	-	-
Shaped Charge Efficiency %	-	-	54	-	-

*J.L. Copp & A.R. Ubbelohde, TrFaradSoc 44, 646-69 (1948), give the velocity of detonation of 60/40 Amatol, charged at density 1.50 gm/cc in a steel tube 17 mm diameter, as 6060 m/sec when prepared with finely ground Ammonium Nitrate, vs 5860 m/sec when using coarse Ammonium Nitrate. W.M. Evans, Proc Roy Soc 204A, 14(1950), gives for 60/40 Amatol 5600 m/sec at density 1.6; for 50/50 Amatol 5850 m/sec at density 1.6; and for 80/20 Amatol 5200 m/sec at density 1.6 gm/cc.

AMATOLO

Italian & Spanish for Amatol.

AMIDOGÈNE

Swiss Black Powder-type explosive.

AMMIACHNAYA SELITRA

Russian for Ammonium Nitrate.

AMMOKSIL or AMMONXYL (mining explosive)

A Soviet mining explosive. There is no corresponding US or foreign composition. See under Soviet Explosives and compare with Soviet Ammonites.

AMMONAL and AMMONAL-TYPE EXPLOSIVES (bursting charge)

a) Foreign Nomenclature:

Austria:	Ammonal
Britain:	Ammonal, Alumatol, Burrowite, Minol & Nobel's 704
France:	Ammonal
Germany:	Ammonal, Ammonpulver
Hungary:	Ammoniás robbano-anyag
Italy:	Ammonal, Nitramite or Avigliana 3 & Toluol-Ammonal
Japan:	Ammonaru
Soviet Union:	Ammonal
Spain:	Amonal

b) Origin:

Invented prior to WW I in Germany as mixtures of Ammonium Nitrate, aluminum & charcoal. Later TNT was added to make the composition easier to detonate and to increase its power and brisance. Between WW I and WW II, several countries omitted charcoal altogether in military Amatols which became simply mixtures of Amatols with aluminum. Sometimes other ingredients were also added.

c) Identifying Features:

Usually gray in color due to the presence of aluminum in the mixture.

d) Chemical Composition:

Ammonals are essentially mixtures of Ammonium Nitrate, powdered aluminum and TNT. Powdered carbon was also used in the early Ammonals which were originally commercial blasting explosives. See Table 2. The composition of some military Ammonals is given in Table 3. See also other compositions, by Country, given under Uses below.

e) Physical Properties:

Ammonals can be cast and compressed to densities as high as 1.65 gm/cc, but such highly compressed mixtures are difficult to detonate without a very strong booster. In order to assure their complete detonation by conventional methods of initiation, Ammonals are usually pressed to a density of about 1.2 gm/cc. However, this density is not sufficient for the safe firing of shells at high velocities because of the danger of premature explosions due to set-back. Usually Ammonal mixtures containing less than 40% TNT must be pressed; those containing 40% TNT and more can be cast.

f) Test Methods and Explosive Characteristics:

In general, Ammonals are fairly insensitive and stable mixtures, but they are hygroscopic due to the presence of Ammonium Nitrate.

US Ammonal 1, shown in Table 3, has a cast density 1.65 gm/cc; brisance (by Sand Test) 47.8 gm vs 48 gm for TNT; power (by Ballistic Mortar) 122% TNT; impact sensitivity 91 cm vs 90 cm for TNT with 2-kg weight (Bureau of Mines Apparatus) and 11 inches vs 14 inches for TNT with 2-kg weight (by Picatinny Apparatus); explosion temperature 265^{o} (decomposes) in 5 seconds; sensitivity to initiation, requires 0.20 gm of Mercury Fulminate; and stability to heat, slightly inferior to TNT. Ammonal 2 is similar in composition to the British "Service Demolition Ammonal" which must be press loaded.

Austrian Ammonal 1 or T has a density 1.6 gm/cc; heat of formation +550 cal/gm; heat of explosion 1465 cal/gm; volume of gas on explosion (including water vapor) 605 liters/kg; temperature developed on explosion 4050^{o}C; velocity of detonation 5400 meters/second; power (by Trauzl Test) 470 cc vs 290 cc for TNT; brisance (by Copper Crusher Test) 2.8 mm vs 3.6 mm for TNT or 78% of TNT; brisance (by Kast formula) 99% of TNT; sensitivity to friction, insensitive; sensitivity to impact, 60 cm vs 90 cm for TNT with 2-kg weight; and specific energy (Abel) 9900 vs 8080 for TNT.

f) Test Methods and Explosive Characteristics (cont'd):

German Ammonals have velocity of detonation as high as 5650 m/sec at a density of 1.62 gm/cc; total volume of gas on explosion 740 liters/kg; maximum pressure (calculated) 2693 kg/sq cm; temperature developed on detonation 3720°C; and specific energy (Abel) 10820 vs 8080 for TNT.

g) Manufacturing Processes:

In the USA, Ammonals are prepared by methods similar to those used for preparing Amatols. The calculated amount of TNT is heated between 85° and 100°C in a steam-jacketed kettle equipped with a mechanical agitator. To this is added gradually, with stirring, powdered Ammonium Nitrate previously preheated to the same temperature as the TNT. Finally the aluminum powder is added and the mass is somewhat cooled while the agitation is continued. If the Ammonal contains less than 40% TNT it must be press loaded, but with 40% TNT or more such a mixture can be cast loaded directly into the ammunition components. In preparing castable mixtures of Ammonals, a dry blend of the powdered aluminum and Ammonium Nitrate can be added, with stirring, to the molten TNT heated in a steam-jacketed kettle.

Ammonals were prepared in France by a method similar to that used to prepare Black Powder. The calculated amounts of the ingredients were wetted with water to a 4% moisture content and then worked for about 1 hour on a wheel similar to that used for milling Black Powder.

h) Safety Hazards:

Due to the presence of aluminum, Ammonals are more sensitive to initiation by impact than TNT. The general effect of incorporating aluminum in Ammonium Nitrate/TNT mixtures is to 1) increase sensitivity to impact, friction, and rifle bullet impact, 2) increase the temperature, and total volume of gas developed on detonation, 3) increase the strength or power, and 4) decrease the velocity of detonation. Ammonals are Class 9, Group I explosives from the stand point of their class quantity-distance storage, and group according to compatibility in mixed storage.

i) Inspection Procedures:

Determination of the composition of Ammonals can be made by extracting the TNT component with anhydrous methylene chloride and, from the residue, extracting the Ammonium Nitrate with water, or identifying it by color reactions. The aluminum, extracted with concentrated hydrochloric acid, can be determined as aluminum-8-hydroxyquinolinate or by other procedures. Any remaining residue, if black, is carbon and, if yellow or brown, the presence of wood meal is indicated.

i) Inspection Procedures (cont'd)

Loaded items of ammunition, stored at elevated temperatures, should be inspected periodically to determine the presence of ammonia, identified by odor or brown coloration of the explosive. Ammonia results from the hydrolysis of Ammonium Nitrate in the presence of moisture. Its presence is very undesirable since ammonia reacts with the TNT component to form a complex addition compound which ignites at 67°C. In addition to this reaction, aluminum reacts with moisture to produce hydrogen which is a highly flammable gas. Therefore, if ammonia is detected in Ammonal-loaded ammunition, it should be washed out with cold water but not by steam.

j) Preservation and Special Handling Requirements:

See item i, Inspection Procedures, above; and item j, under AMATOL.

k) Storage:

Ammonals prepared from high purity ingredients and adequately protected from moisture are not affected by prolonged storage at normal temperatures. But even if a small amount of moisture is absorbed, particularly at high temperatures, the aluminum (especially if impure) reacts with this moisture, resulting in the evolution of hydrogen gas. Ammonals in the presence of moisture also react with copper, bronze, lead, and copper-plated steel. See also Storage under AMATOL.

l) Demilitarization and/or Disposal Procedures:

Heat should never be applied to remove Ammonal from loaded ammunition if the smell of ammonia is noticed, or if the explosive has a brown color. The filler can be washed out with a stream of cold water; otherwise, it can be destroyed as described under AMATOL.

m) Uses:

Originally, Ammonals were not considered very favorably for military applications due to the shortage and high price of aluminum powder, and because the full effectiveness of aluminum in explosives was not realized. During WW II the use of Ammonals became very popular, and several new formulations were developed for a wide variety of uses in ammunition.

m) Uses (cont'd)

Ammonals are known to be used in Britain, France, Germany, Italy, Russia, Spain & USA. For further information on specific compositions and uses, see Tables 2 & 3 and under individual country country in Country Index.

In the United States, Ammonals are used in Shells for testing purposes due to the brilliant flash produced on explosion of the charge. See compositions given in Table 3.

TABLE 2

Commercial Blasting Ammonals

Components	Felixdorf Factory Ammonal (Austrian)				Ammonal (German)	
	a	b	c	d	A	B
NH_4NO_3	80.75	90.0	88.0	80.0	72.0	93 - 95.5
KNO_3	-	-	-	-	-	-
$Ba(NO_3)_2$	-	-	-	-	-	-
Al(powder)	15.00	4.0	8.0	18.0	23.5	2.5 - 3.5
Alloy Al/Zn	-	-	-	-	-	-
Red Charcoal	-	-	-	-	4.5	-
Charcoal	4.25	6.0	4.0	2.0	-	2 - 3
Pitch	-	-	-	-	-	-
$K_2Cr_2O_7$	-	-	-	-	-	-
TNT	-	-	-	-	-	-
Moisture	-	-	-	-	-	0 - 1

Components	Ripping Ammonal (British)	St Helen's Powder (British)	Nuevo Anagon (Spanish)	Ammonal Spanish)	German Ammonal *
NH_4NO_3	84 - 87	92 - 95	70.0	84.5	91.3
KNO_3	-	-	-	1.5	-
$Ba(NO_3)_2$	-	-	-	0.5	-
Al(powder)	7 - 9	2 - 3	-	5.5	1.7
Alloy Al/Zn	-	-	20.0	-	-
Red Charcoal	-	-	-	-	-
Charcoal	2 - 3	-	10.0	8.0	-
Pitch	-	-	-	-	6,7
$K_2Cr_2O_7$	3 - 4	-	-	-	-
TNT	-	3 - 5	-	-	0.3
Moisture	0 - 1	0 - 1	-	-	-

*Was also used for military purposes, but required a booster charge for detonation.

Table 2 (Cont'd)

Marshall cites the properties obtained by Bichel for Ammonal A in comparison with those for Dynammon containing Ammonium Nitrate 95.5% & red charcoal 4.5%:

Explosive	Density d	Vel of Deton m/sec	Heat of Expln cal/g	Total Vol of Gases l/kg
Dynammon	865	3380	727.0	976
Ammonal A	900	3450	1600.5	594

Explosive	Vol of Gases at NTP (minus H_2O vapor) l/kg	Expln Press (Calcd) kg/cm^2	Power by Trauzl Test, cc
Dynammon	360	3668	250
Ammonal A	418	9425	329

TABLE 3

Military Ammonals of WW II

Components	US 1	US 2**	US 3	Austrian 1 or T	Austrian 2	British Service Demolition	British Roth 1904
NH_4NO_3	22.0	72.0	65.0	46.0	58.6	64.0	47.0
Al (powder)	11.0	16.0	32.0***	22.0	21.0	18.0	22.0
TNT	67.0	12.0	15.0 (added)	30.0	18.0	15.0	30.0 (or DNT)
Charcoal	-	-	3.0	-	2.4	3.0	1.0
Red Charcoal	-	-	-	2.0	-	-	-

Components	French S	French C	German 1	German 2
NH_4NO_3	86.0	76.0	54.0	44.9
Al (powder)	8.0	13.0	16.0	24.1
TNT	-	-	30.0	31.0
Stearine	6.0	-	-	-
NH_4SCN*	-	11.0	-	-

*According to T.L. Davis, the incorporation of ammonium thiocyanate (NH_4SCN) into Ammonals produces mixtures which are unstable to heat.

**It was also used in Germany.

***Aluminum was 16% coarse and 16% fine powder.

AMMONALMATRIT No 98 (blasting explosive)

A Soviet commercial blasting explosive. There is no corresponding US explosive. See Almatrit under Soviet Explosives.

AMMONALSALPETER SPRENGSTOFF

German Ammonium Nitrate Dynamite.

AMMONARU

Japanese for Ammonal.

AMMONCARBONIT (blasting explosive)

A German Ammonium Nitrate permissible explosive. Several countries use somewhat similar compositions. See under German Explosives.

AMMON DINAMITE

Italian Ammonium Nitrate Dynamite.

AMMONDYNAMIT

German Ammonium Nitrate Dynamite.

AMMON GELATINA

Italian Ammonium Nitrate Gelatin Dynamite.

AMMONGELATIN DYNAMIT

Swedish Ammonium Nitrate Gelatin Dynamite.

AMMONGELATINE

German Ammonium Nitrate Gelatin Dynamite.

AMMON-GELATINE DYNAMITE (blasting explosive)

A current British commercial blasting explosive. Several countries use somewhat similar compositions based on Ammonium Nitrate, Nitroglycerin & carbonaceous fuel.

AMMON-GELIGNITE (blasting explosive)

A current British commercial blasting explosive. Several countries use somewhat similar compositions based on Ammonium Nitrate, Nitroglycerin & carbonaceous material.

AMMONIAKKRUT

Swedish Ammonium Nitrate Dynamite.

AMMONIINAYA (or AMMONIYNAYA) SELITRA

Russian for Ammonium Nitrate.

AMMONIT

German & Russian for Ammonite.

AMMONITE (commercial blasting explosive)

See also BELLITE.

a) Foreign Nomenclature:

Belgium:	Ammonite & Explosif Favier n°1
Britain:	Ammonite
France:	Ammonite & Explosif Favier type N n° 1c
Germany:	Ammonit
Italy:	Ammonite
Soviet Union:	Ammonit & Skal'nyi ammonit
Spain:	Ammonita

b) Origin:

A type of Ammonium Nitrate commercial explosive known since 1884. It has been manufactured since that time in many variations of composition by several European countries. Ammonites are apparently not now extensively manufactured in western Europe, but are still very much in use in the USSR.

c) Identifying Features:

Color may be white, but is usually brown. It may be either a powder or plastic putty-like material.

d) Chemical Composition:

Ammonites are mechanical mixtures of Ammonium Nitrate plus a variety of aromatic nitro compounds and other ingredients. See Table 4, below under Uses and by country.

e) Physical Properties:

All Ammonites must be compressed, usually in cylindrical paper cartridges which are then wrapped in paper and waterproofed. The high Ammonium Nitrate content renders all Ammonites extremely hygroscopic, and they will deteriorate during prolonged storage. See also Table 4.

f) Test Methods and Explosive Characteristics:

Ammonites are subjected to the standard tests which all commercial mining or blasting explosives must pass to be safe or to be placed on a "Permitted List". In general, they have low sensitivity to both friction and shock.

g) Manufacturing Processes:

The thoroughly pulverized ingredients are blended and then heated, by indirect steam or hot water, above the melting point of the nitrocompound. The mixture is cooled without stirring. This treatment results in the Ammonium Nitrate grains being coated with the non-hygroscopic nitrocarbon. The Ammonite is then press loaded into an appropriate cartridge in the same manner as most dynamites.

h) Safety Hazards:

See under AMMONIUM NITRATE. Ammonites are Class 12, Group D explosives for quantity-distance and compatibility storage classifications.

i) Inspection Procedures:

See under AMMONIUM NITRATE.

j) Preservation and Special Handling Requirements:

See under AMMONIUM NITRATE.

k) Storage:

See under AMMONIUM NITRATE.

l) Demilitarization and/or Disposal Procedures:

See under AMATOL and under AMMONIUM NITRATE.

m) Uses:

Some Ammonites are used as commercial blasting explosives in the mining of coal, especially where the accumulation of methane-air mixtures ("firedamp") and coal dust-air mixtures may be ignited by the high detonation temperatures of other explosives not having the characteristics of Ammonites. Their detonation temperatures are comparatively low; moreover, the detonation products cool rapidly and will not ignite the atmosphere surrounding them. Some Ammonites have been used in military applications, particularly as substitute fillers for high explosives based on TNT or Nitroglycerin.

Ammonites are known to be used in Britain, France, Germany, Italy, USSR, Spain & USA. For specific compositions of some mixtures and their uses, see under individual country.

In the United States, commercial explosives intended for use in mining and blasting operations are called "Permissible or Safety Explosives". These explosives, after extensive tests to determine their suitability, must be approved by the Bureau of Mines, US Department of Interior. An extensive list of such approved explosives is available from the Bureau of Mines.

TABLE 4

German Ammonites Used During WW II

Components and some Properties	No ?	43A	43B *	43C **	No ?	H1	H5	No ?	No ?	No ?
Amm nitrate	42.0	46.0	56.0	45.0	46.0	50.0	50.0	55.0	52.0	50.0
Na nitrate	9.8	-	8.0	-	-	-	5.0	5.0	8.0	
Ca nitrate, $4H_2O$	-	8.0	6.0	10.0	8.0	15.0	15.0	10.0	7.0	15.0
Mg nitrate, $6H_2O$	8.4	-	-	-	-	-	-	-	-	
Guanidine nitrate	-	8.0	10.0	15.0	-	-	-	-	-	10.0
PETN	9.8	-	2.0	-	-	10.0	-	-	-	-
PH-Salz	-	-	5.0	-	46.0	-	10.0	10.0		
RDX	30.0	8.0	7.0	-	-	25.0	20.0	20.0	25.0	25.0
Tetra-Salz	-	-	-	-	-	-	-	-	8.0	-
TNT	-	30.0	10.0	30.0	-	-	-	-	-	-
"Vultamol" (emulsifier) (added)	-	0.3	0.3	0.5	-	-	-	-	-	-
Density (cast) gm/cc	-	1.58	1.61	-	-	-	-	1.53	1.50	-
Casting Temperature, °C	-	104	105	-	-	-	-	108	112	-
Density of Fragmentation	41	-	38	-	39	-	-	40	41	

*The composition given by G. Römer "Report on Explosives" (1945), PB Rpt No. 85[illegible], totals 104.

**Ammonit 43C exploded in 1944 on a loading line and its manufacture was discontinued. It is reported that mixtures of TNT with guanidine nitrate are unstable.

Most of these mixtures are suitable for loading bombs, grenades and shells.

AMMONIT-GOUDRONIT (mining explosive)

A Soviet commercial blasting explosive. There is no corresponding US composition. See under Soviet Explosives and compare with Ammonpek.

AMMONIT, PREDOKHRANITEL'NYI (Permissible coal mining explosive)

A current Soviet commercial blasting explosive. There is no corresponding US composition. See under Soviet Explosives and compare with Ammonit.

AMMONIUMNITRAT

Swedish for Ammonium Nitrate.

AMMONIUMNITRAT or AMMONIUMSALPETER

German for Ammonium Nitrate.

AMMONIUM NITRATE (explosive ingredient of dynamites & ammunition fillers)

a) Foreign Nomenclature:

Belgium:	Nitrate d'ammoniaque
China:	Hsiao Hsuan An
France:	Nitrate d'ammoniaque
Germany:	Ammoniumnitrat, Ammonnitrat & Ammonsalpeter
Hungry:	Ammoniumnitrát & Ammonsalétrom
Italy:	Nitrato ammonico & Nitrato d'ammonio
Japan:	Ammonum Shosanen
Poland:	Saletra amonowa
Soviet Union:	Ammiachnaya selitra, Ammoniynaya (Ammoniinaya) selitra & Azotnokislyi ammonii
Spain:	Nitrato amónico
Sweden:	Ammoniumnitrat
Switzerland:	Ammonnitrat

b) Origin:

The first description of its preparation and properties was in 1659 by Glauber who treated ammonium carbonate with nitric acid and called the resulting salt "Nitrumflammans". Grindel & Robin early in the 19th century were the first to use Ammonium Nitrate in explosives as a replacement for potassium nitrate in Black Powder. In 1867 the Swedish chemists J.V. Ohlsson & J.H. Norrbin obtained the first patent on an explosive called "Ammoniakkrut". It was a composite dynamite consisting of Ammonium Nitrate with a small amount of other ingredients.

c) Identifying Features:

Colorless, hygroscopic crystals melting at 169.6°C. The pure compound boils at 210°C & 11 mm pressure and can be distilled practically without decomposition. At atmospheric pressure it decomposes above its melting point and will deflagrate at 325°C. It is soluble in water, ethyl alcohol, methyl alcohol and other organic solvents containing OH or NH groups.

d) Chemical Composition:

Formula NH_4NO_3, molecular weight 80.05, contains the following percentages by weight of the elements: Nitrogen 35.00%, hydrogen 5.04%, oxygen 59.96%. Its oxygen balance to water and nitrogen gas is +20%, thus making it one of the most attractive and the principal energy gas-producing substance in the commercial explosives industry.

e) Physical Properties:

Ammonium Nitrate exists in five allotropic modifications of the solid crystals. The liquid forms regular cubic crystals on solidification. When cooled, these crystals undergo various transitions to other forms. The crystal density is 1.725 at 25°C, apparent density varies widely with granulation. It is 1.06 gm/cc or higher for that granulation used for the manufacture of Amatol. Compositions containing Ammonium Nitrate may be either press- or cast-loaded mixtures, depending upon the percentage aromatic nitrocompound added. Unless protected by some coating or protective barrier, Ammonium Nitrate is extremely hygroscopic. It will corrode iron, steel, brass, lead and cadmium.

f) Test Methods and Explosive Characteristics:

Ammonium Nitrate is the least sensitive to impact of any of the military explosives. It has a low ability to propagate a detonation wave and if a charge is long and of small diameter or unconfined, the detonation wave may die out before it reaches the opposite end of the charge. Some other explosive properties include: Brisance (by Lead Cylinder Compression Test) 54% of TNT; detonation rate varies from 1000 to 3000 meters/sec depending on conditions and methods of testing; flash point 500°C; friction sensitivity cannot be detonated by a steel shoe; gas evolved on detonation 980 liters /kg; heat of combustion 628 cal/gm; heat of decomposition 323 cal/gm; heat of explosion 346 cal/gm; heat of formation 87 kcal/mole at constant pressure; power (by Trauzl test) 55% of TNT; rifle bullet impact test -unaffected; sensitivity to initiation by detonators & boosters-more difficult to detonate or explode than any of the standard military explosives, sensitivity is increased by confinement, temperature, lower density and the presence of organic materials; sensitivity to initiation by heat-ignition temperature 465°C for unconfined sample, 260 to 360°C when under confinement; and stability in storage-despite its hygroscopicity, very stable in storage at temperatures up to 150°C, although slight decomposition may occur under certain conditions.

g) Manufacturing Processes:

Until WW I, Ammonium Nitrate was manufactured chiefly by neutralizing, with weak nitric acid, the ammonia present in aqueous by-products of the artificial gas & coking industries. As the nitric acid was then manufactured from Chile saltpeter, it contained hydrochloric acid, nitrous acid and boric acid as impurities, while the gas liquor ammonia used contained pyridine and thiocyanates. Consequently, the Ammonium Nitrate also contained these same impurities. This Ammonium Nitrate was suitable for use in blasting explosives and in mixed fertilizers. When the manufacture of nitric acid was begun from ammonia produced from atmospheric nitrogen, this acid was of a higher degree of purity. It was neutralized with synthetic ammonia, and the Ammonium Nitrate thus produced was much purer than that obtained by the earlier process.

g) Manufacturing Processes (cont'd):

Other processes for manufacturing Ammonium Nitrate include:

1) Double decomposition of calcium nitrate and ammonium carbonate (or sulfate);
2) Double decomposition of ammonium sulfate and sodium nitrate in solution;
3) Using sodium nitrate instead of common salt in the ammonia-soda process;
4) Mixing the gases (nitrogen dioxide, oxygen & steam) obtained as by-products of ammonia oxidation plants with ammonia gas and extra air in order to produce the desired reaction;
5) Fauser Process - a method originated in Italy and has assumed considerable importance in Europe. It is based on the neutralization of aqueous nitric acid by gaseous ammonia under conditions which completely use the heat of neutralization under pressure;
6) Bamag-Meguin A.-G. Process - introduces nitric acid solution and ammonia gas into the lower part of a mass of fused Ammonium Nitrate at about 150°C at atmospheric pressure;
7) Caro and Frank Process - a batch or continuous process in which solid, dry Ammonium Nitrate is first introduced; then ammonia gas and 95% nitric acid in equivalent amounts are added to the reaction vessel;
8) Toniolo Process - Yields a dry product by pouring or spraying molten Ammonium Nitrate of 10% water content over dry material or by melting the dry salt with the molten wet salt;
9) Stengel Process - neutralization of ammonia with pre-heated nitric acid takes place in a reactor at 204°C;
10) Tennessee Valley Authority Process and recent patents assigned to the duPont Company.

    Some later achievements and methods of evaporating & crystallizing aqueous Ammonium Nitrate solutions include continuous vacuum crystallization and continuous graining or prilling processes.

h) Safety Hazards:

Ammonium Nitrate is classified as an "explosive ingredient" and oxidizing material. Some disastrous explosions have occurred in the past usually because of unduly high temperatures, confinement, or the presence of organic materials. Its manufacture, use,

h) Safety Hazards (cont'd):

storage distribution and possession (in the USA) are regulated by the Federal Explosives Act, administered by the US Bureau of Mines. A yellow label, the same as for ammonium perchlorate, is required on all railroad shipments. For purposes of quantity-distance storage and compatibility group storage, Ammonium Nitrate is a Class 12, Group D explosive.

i) Inspection Procedure:

A fairly pure sample should be white and entirely soluble in water, giving a solution neutral to litmus. A few drops of Nessler's reagent added to 2 to 3 ml of the solution will turn the liquid dark yellow to reddish-brown (for small percent) or form a brown precipitate (for large percent). If it is desired to detect Ammonium Nitrate in the absence of other inorganic or organic nitrates, pour 2 ml of DPhA reagent (1 gm diphenylamine in 100 ml concentrated sulfuric acid) down the wall of a test tube containing 5 ml of the solution. A blue ring at the interface indicates a nitrate.

The sample may be tested for residue by heating a small quantity in a crucible. A pure sample should be completely volatile and practically free from residue. The presence of a residue may indicate other nitrates, sulfates or chlorides. Sodium nitrate is indicated if a yellow color is produced in a flame by a platinum wire dipped into a hot saturated test solution. Chlorides are present if a few drops of silver nitrate produce a white precipitate. Sulfates are tested for with barium chloride, calcium with ammonium oxalate, and magnesium with ammonium phosphate after removing any calcium found.

See also under AMMATOL and AMMONAL.

j) Preservation and Special Handling Requirements:

Ammonium nitrate is extremely hygroscopic. In the presence of moisture, it reacts with copper to form a compound (tetraminocupric nitrate), which is as sensitive to impact and as brisant as Lead Azide. For this reason, tools of copper, brass or bronze should not be used in handling Ammonium Nitrate or explosive mixtures containing it. It also reacts with and corrodes iron, steel, lead, cadmium and zinc. The only materials known to be definitely suitable as protective coatings, over

j) Preservation and Special Handling Requirements (cont'd):

long periods of time, for containers or ammunition loaded with Ammonium Nitrate compositions are polyvinyl chloride and epoxy resins. Other materials such as acid-proof black paint, shellac, baked oil & rubber paints have not proved successful.

In order to prevent the adsorption of moisture and subsequent caking of Ammonium Nitrate in storage, numerous coatings & water-repellent agents are used. Materials such as diatomaceous earth or kaolin clay are applied as coatings (0.5 to 1.0%) to the dried particles called "prills". Other materials such as coatings of methyl cellulose, chalk, silica, alumina, "acid magenta", and sodium polymetaphosphates are also suitable.

k) Storage:

Despite its hygroscopicity, Ammonium Nitrate is very stable in storage at ambient temperatures for prolonged periods of time. It can be subjected to temperatures as high as 100°C for 100 days without appreciable decomposition. Decomposition does not appear to begin until the compound is heated to temperatures near its melting point (170°C). Admixtures of Ammonium Nitrate with TNT or other aromatic nitrocompounds are stable at temperatures less than 120°C. However, the sensitivity of Ammonium Nitrate to heat is increased by the presence of organic materials such as cellulose, paper, carbon, waxes, sawdust, oil or paraffin. Therefore, these or other flammable materials should not be stored with or adjacent to Ammonium Nitrate containers or ammunition loaded with its admixtures.

l) Demilitarization and/or Disposal Procedures:

Due to its high solubility in water, Ammonium Nitrate can be rendered useless by flooding it with large volumes of water. Steam can be used to destroy or to remove some Ammonium Nitrate compositions from loaded ammunition components. It is also moderately soluble in ethyl alcohol and methyl alcohol at normal temperatures.

It is decomposed by strong alkalies with the liberation of ammonia, and by sulfuric acid with the formation of ammonium sulfate and nitric acid.

See also under AMATOL and AMMONAL.

m) Uses:

Ammonium Nitrate is one of the most widely used components of explosives, both in commercial and military types. It is also used universally as a nitrogenous fertilizer. When used as a fertilizer, it does not have to meet the standard of purity (99%) required by its use as an explosive. Manufacturing facilities used to produce fertilizer grade Ammonium Nitrate can also produce the purer grade without any additional conversion equipment.

Because of its insensitivity, Ammonium Nitrate is seldom used alone. It is commonly used as an explosive extender in such mixtures as AMATOL (qv) and AMMONAL (qv); in blasting, cratering & demolition explosives such as AMMONITE (qv); and in some solid "composite propellants".

Ammonium Nitrate is known to be used in Belgium, Britain, France, Germany, Italy, Japan, USSR, Spain, & USA. For further information on specific compositions and uses, see Tables 5, 6 & 7 and under individual country in the Country Index.

See also AMMONIUM NITRATE DYNAMITE & GELATIN DYNAMITE.

In the United States, Ammonium Nitrate Dynamites are a type of "straight" dynamite in which up to 50% of the liquid nitric esters (Nitroglycerin + antifreeze additives) is replaced by Ammonium Nitrate. These explosives originated in the USA about 50 years ago. They are noted for their heaving rather than shattering effects, and their strength is lower than that of straight dynamites. Some are used for military purposes such as demolition, excavation and cratering operations. These explosives are not suitable for use in coal mines except for "strip mining" work, called "open-cast mining" by the British. Some typical US compositions and their properties are given in Table 7.

TABLE 5

European Ammonium Nitrate Dynamite

Composition, %	British	French 1	French 2	French 3
Ammonium Nitrate	80	45	75	75
Nitroglycerin	10	40	20	22
Sodium nitrate	-	5	-	-
Wood or Cereal meal	10	10	5	-
Charcoal	-	-	-	3

Oxygen Balance to CO_2, %	-	+0.75	+9.7	+7.8
Density, gm/cc	1.0	1.38	1.20	1.33
Lead Block Expansion, cc/10 gm sample	-	400	335	330
Lead Block Crushing, mm		22.0	15.5	16.0
Power, % Blasting Gelatin	78	-	-	-

TABLE 6

Ammonium Nitrate Gelatins

Composition (%) and some properties	USA (Non-Permissible)					Belgian (Non-Permissible)		British (Not-Permitted)		French (Non-Permissible)			
	30%	40%	50%	60%	-	Forcites	Forcite Extra	Ammon-Gelatine Dynamite	Ammon-Gelignite	Semi-Gelatine	Dynamite 0	Forcite Extra	Grisou-dynamite-roche
Nitroglycerin	22.9	26.2	29.9	35.3	45.0	36-64	63.0	33.0	25.7	15.0	50.0	64.0	29.0
Collodion cotton	0.3	0.4	0.4	0.7	2.5	2-3.5	2.0	1.3	0.9	0.3	2.5	3.5	1.0
Amm nitrate	4.2	8.0	13.0	20.1	45.0	0-25	30.0	59.2	57.8	78.7	44.5	25.0	70.0
Na nitrate	54.9	49.6	32.0	33.5	-	0-35	-	-	-	-	-	-	-
K nitrate	-	-	-	-	-	0-46	-	-	-	-	-	-	-
Carbonaceous fuel	8.3	8.0	8.0	7.9	7.5	6.5-15	5.0	6.5	5.8	6.0	3.0*	6.5**	-
Sulfur	7.2	5.6	3.4	-	-	-	-	-	-	-	-	-	-
Inert ingredients	-	-	-	-	-	-	-	-	9.8	-	-	-	-
Anti-acid	0.7	0.8	0.7	0.8	-	1.0	-	-	-	-	-	1.0	-
Moisture	1.5	1.4	1.6	1.7	-	-	-	-	-	-	-	-	-
Density, gm/cc	-	-	-	-	-	-	1.44	1.5	1.5	1.2	-	-	-
Rate of Deton, m/sec	4400	4900	5300	5700	-	-	7000	-	-	-	-	-	-
Ballistic Pendulum, percent TNT	83	88	92	97.5	-	-	-	-	-	-	-	-	-
Pb Block Expansion, cc/10g sample	-	-	-	-	-	-	485	-	-	-	-	-	-
Lead Block Crushing, mm	-	-	-	-	-	-	21.0	-	-	-	-	-	-
Power, % of Blasting Gelatin	-	-	-	-	-	-	-	90	78	82	-	-	-

*Carbonaceous fuel consists of 2.5% cereal meal and 0.5% lamp-black.
**Wood meal.

TABLE 7

US Ammonium Nitrate Dynamites

Designation and Strength

Composition (%) and some properties	USA		USA "Ordinary"					USA Low-Freezing				Monobel (permissible USA)
	-	-	20%	30%	40%	50%	60%	30%	40%	50%	60%	
Nitroglycerin	9.50	9.50	12.0	12.6	16.5	16.7	22.5	13	17	21	27	10
Nitroglycol	-	-	-	-	-	-	-	3	4	5	6	-
Amm nitrate	79.45	69.25	11.8	25.1	31.4	43.1	50.3	15	20	25	30	80
Na nitrate	-	10.20	57.3	46.2	37.5	25.1	15.2	53	45	36	27	-
Carbonaceous fuel	9.75(a)	9.65(a)	10.2	8.8	9.2	10.0	8.6	15(b)	13(b)	12(b)	9(b)	10
Sulfur	-	-	6.7	5.4	3.6	3.4	1.6	-	-	-	-	-
Anti-acid	0.40	0.50	1.2	1.1	1.1	0.8	1.1	1	1	1	1	-
Moisture	0.90	0.90	0.8	0.8	0.7	0.9	0.7	-	-	-	-	-
Density, gm/cc	-	-	1.30	1.31	1.28	1.26	1.28	-	-	-	-	-
Rate of Deton, m/sec	-	-	2700	-	3300	3900	4600	-	-	-	-	-
Ballistic Pendulum, % TNT	-	-	89	-	91	99	109	-	-	-	-	-
Lead Block Expansion, cc/g sample	-	-	19.9	-	27.5	-	34.7	-	-	-	-	-

(a) The carbonaceous combustible material (such as wood pulp and flour) contains 0.40% of grease or oil which is added to AN to counteract its hygroscopicity.

(b) The carbonaceous combustible material of these US dynamites is mixed with some sulfur.

AMMONIUM NITRATE DYNAMITE (blasting explosive)

a) Foreign Nomenclature:

Belgium: Alkalite, Alsilite, Bellite, Centralite RII & TA, Explosifs brisants, Explosifs de Favier, Explosifs SGP, Flammivore, Fractorite CA, Matagnite, Minolite antigrisouteuse, Nitroboncellite, Nitrocooppalite V & VIII, Permite, Permonite SGP, Ruptol B & Sabulite

France: Explosif antigrisouteu, Explosif de Favier & Forcite extra

Germany: Aldorfit, Ammoncarbonit, Ammondynamit, Ammongelatine, Ammonsalpeter Sprengstoff, Donarit, Fulmenit, Romperit 1

Italy: Afocite, Astralite, Dinamon, Esplosivo da mina polverulento con nitroglicerina, & Imperialite

Japan: Ammonyaku, Ko-Shoan Bakuyaku, L-Shoan, Shin-Toku-Shoan, Shoan Bakuyaku, Shoanyaku

Soviet Union: Ammoksil or Ammonxyl, Ammonit, Ammonit-Goudronit; Ammonit, Predokhranitel'nyi; Ammonpek, Ammonsol, Belit, Dinamon, Igdanit & Pobedit

Spain: Dinamon, Donarita & Explosivo de seguridad

Sweden: Ammoniakkrut & Seranin

Switzerland: Aldorfit & Ammondynamit

b) Origin:

Nobel gave the name Dynamite to mixtures of Nitroglycerin & kieselguhr. Later it was found that stronger Dynamites could be made by substituting sodium nitrate & a combustible absorbent for the kieselguhr. Subsequently, the replacement of part of the Nitroglycerin & sodium nitrate by Ammonium Nitrate brought into existence the less costly "Ammonia Dynamite" (Ammonium Nitrate Dynamite).

c) Characteristics:

For the composition & some characteristics of Ammonium Nitrate Dynamites, see the above entries under the country indicated.

d) Uses:

Ammonium Nitrate Dynamites are used universally for blasting operations. Because of their great heaving force and relatively low rate of detonation, they are used primarily for blasting soft rock & earth.

See also AMMONIUM NITRATE and DYNAMITES.

AMMONIUM NITRATE EXPLOSIVES

See Explosif nitraté or Explosif du Type N under French Explosives, and Explosivos de seguridad under Spanish Explosives.

AMMONIUM PICRATE or EXPLOSIVE D (bursting charge)

a) Foreign Nomenclature:

Britain:	Explosive "D" (Dunnite), Ammonium Trinitrophenolate
France:	Picrate d'ammoniaque
Germany:	Ammoniumpikrat
Hungary:	Dunnit robbanóanyag
Italy:	Picrato ammonico & Picrato d'ammonio
Japan:	Pikurinsan Ammonia
Soviet Union:	Pikrat ammonia, Pikrinovokislyi ammónii
Spanish:	Picrato amónico

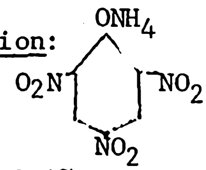
b) Origin:

It was first prepared in 1841 by Marchand and used in explosive compositions, in 1869, called Abel Powder or Picric Powder (British Explosive) and Brugère Poudre (See under French Explosives). Since 1900 it has been used as an ingredient of military propellent & high explosive compositions. The terms Explosive D or Dunnite were code names originally applied to keep the composition secret. These names stand for Dunn (Beverly W.), an American officer and ordnance expert, who introduced the use of Ammonium Picrate as a filler for armor-piercing projectiles.

c) Identifying Features:

Yellow to orange crystalline compound melting with decomposition at 265-270°C. It is very soluble in hot water; slightly soluble in hot acetone or hot ethyl alcohol; and practically insoluble in ether, ethyl acetate & octyl alcohol.

d) Chemical Composition:



Formula , molecular weight 246.14, contains the following percentages by weight of the elements: Nitrogen 22.7%, hydrogen 2.4%, oxygen 45.6%, carbon 29.3%. Its oxygen balance to carbon dioxide and water is -52%.

e) Physical Properties:

Ammonium Picrate exists as yellow monoclinic crystals representing a stable form, and as red rhombic crystals representing a metastable form. The two forms are interconvertible and do not differ in explosive properties. The pure compound has a crystal density of 1.719 gm/cc. It can be compressed at pressures of 5000, 10000, 20000, 50000, and 100000 psi to density values of 1.41, 1.47, 1.53, 1.59, and 1.64 gm/cc respectively. It is not markedly toxic, but discolors the skin and may cause dermatitis. Inhalation of the dust should be avoided and frequent washing of exposed areas and frequent changes of clothes are desirable for those working with large quantities of the material.

f) Test Methods and Explosive Characteristics:

Ammonium Picrate is distinctly less sensitive to impact than TNT. Its slightly greater sensitivity to rifle bullet impact is attributable to the much lower temperature required for explosion by heat (318°C) than that for TNT (475°C). It is also relatively insensitive to initiation. In the sand test, it is not initiated by either Lead Azide or Mercury Fulminate alone; a booster charge of 0.06 gm of Tetryl is required. Moisture has a marked effect on the sensitivity of Ammonium Picrate to initiation, the presence of moisture causes an increase in the amount of booster charge required for its initiation.

The brisance of Ammonium Picrate, as measured by the sand test, is 77% that of TNT. But when compressed to a density of 1.53 gm/cc, it is shown by fragmentation tests to be 95% as brisant as TNT. The ballistic pendulum test shows Ammonium Picrate to be 98% as powerful as TNT. This combination of brisance and power, together with its relative insensitivity, makes this explosive suitable for use in loading armor-piercing projectiles. However, it cannot be melt loaded and is partially replaced by Picratol (qv) which can be melt loaded.

g) Manufacturing Processes:

Picric Acid (trinitrophenol) is suspended in hot water, in which it is partially soluble, and neutralized by either gaseous or aqueous ammonia. The reaction is slightly exothermic. On cooling the solution, the picrate separates as yellow crystals which are washed with cold water and dried. An excess of ammonia leads to formation of the red form. This should be avoided.

h) Safety Hazards:

Dry Ammonium Picrate is chemically not very reactive. In the presence of moisture, it reacts with metals, but less readily than Picric Acid, to form sensitive & dangerous picrates. The presence of traces of these picrates will increase the sensetivity and lower the detonation temperature of Ammonium Picrate. For purposes of quantity-distance storage and compatibility group storage, Ammonium Picrate is a Class 9, Group I explosive.

i) Inspection Procedure:

The color requirement, yellow to orange, is intended to eliminate the presence of even a small amount of the red form. Strong alkalies decompose Ammonium Picrate into Picric Acid & ammonia. This reaction is the basis of one method for determining purity of the material.

j) Preservation and Special Handling Requirements:

Ammonium Picrate is not hygroscopic when exposed to humid air but its direct contact with moisture should be avoided. It is extremely stable under normal conditions of storage (qv).

k) Storage:

Tests of Ammonium Picrate during magazine storage over a period of 20 years show it to undergo no change in stability. Storage of either the yellow or red form at 50°C for 3 years causes such an increase in sensitivity to initiation that it can be initiated by Mercury Fulminate alone. Subsequent storage at magazine temperature (2 to 6 years) causes the explosive to return to its original condition of sensitivity. Storage at 65°C for 1 year causes no apparent deterioration of Ammonium Picrate. While storage at elevated temperatures for prolonged periods of time causes some increase in sensitivity to initiation,

k) Storage (cont'd):

such storage does not change its color, brisance or stability. Therefore, Ammonium Picrate is considered an extremely stable explosive.

l) Demilitarization and/or Disposal Procedures:

Ammonium Picrate is decomposed by dissolving it in 30 times its weight of a solution prepared by dissolving 1 part of hydrated sodium sulfide ($Na_2S \cdot 9H_2O$) in 6 parts of water.

Steam can be used to remove Ammonium Picrate or Picratol from loaded ammunition components.

Destruction of scrap Ammonium Picrate or loaded ammunition is best accomplished by detonating it in appropriate piles or dumping the larger items at sea.

m) Uses:

The insensitivity of Ammonium Picrate to shock makes it a suitable bursting charge for armor-piercing projectiles. It is also an ingredient of Picratol which can be cast loaded, and is used in some propellent compositions.

Ammonium Picrate is known to be used in Britain, Germany, Japan & USA.

For further information on uses, see under individual country in the Country Index.

AMMONIUM TRINITROCRESYLATE

See Ecrasite under Italian Explosives, Ekrasit under Soviet Explosives, and Ecrasita under Spanish Explosives.

AMMONIYNAYA (or AMMONIINAYA) SELITRA

Russian for Ammonium Nitrate.

AMMONPEK (mining explosive)

A Soviet coal mining explosive. There is no corresponding US composition. See under Soviet Explosives.

AMMONPENTRINIT (blasting explosive)

A series of Swiss blasting explosives containing PETN/Nitroglycerin/Ammonium Nitrate. There are no corresponding US compositions. See under Swiss Explosives.

AMMONPULVER

German name for Ammonal.

AMMONTOL (bursting charge)

A Soviet castable high explosive. There is no corresponding US composition. See under Soviet Explosives and compare with Ammoksil.

AMMONUM SHOSANEN

Japanese for Ammonium Nitrate.

AMMONXYL

See Ammoksil under Soviet Explosives.

AMMONYAKU

Japanese Ammonium Nitrate Dynamite.

AMMOSOL'

Soviet permissible Ammonium Nitrate Dynamite.

AMONITA

Spanish for Ammonite.

ANBENYAKU or SHŌBENYAKU (bursting charge)

A Japanese high-explosive charge. Also a Japanese blasting explosive by the same name. There are no corresponding US compositions. See under Japanese Explosives.

ANGAYAKU (bursting charge)

Japanese high explosive compositions. One such composition consisting of RDX and wax can be considered similar to Composition A used by the British & USA; otherwise there are no similar US compositions. See under Japanese Explosives.

ANS or ANTISANZIONITE (bursting charge)

Italian Ammonium Nitrate, castable explosive composition. There is no corresponding US composition. See under Italian Explosives.

ARIONITE (permissible mining explosive)

A current Belgian mining explosive developed and manufactured in Belgium. There is no corresponding US composition. See under Belgian Explosives.

ARTIFICES or PYROTECHNIE

French for Pyrotechnic Compositions. See Pyrotechnie under French Explosives.

ARTIFIZI da GUERRA or PIROTECNIA

Italian for Pyrotechnics. See Pirotecnia under Italian Explosives.

AS-3 (priming & igniting composition)

A German, electric fusehead Priming & Igniting Composition. See under German Explosives.

ASN ESPLOSIVO (or ASN MISCELA) (bursting charge)

A current Italian main high-explosive charge. There is no corresponding US composition. See under Italian Explosives.

ASTRALIT

German for Astralite.

ASTRALITA

Spanish for Astralite.

ASTRALITE (blasting explosives)

a) Foreign Nomenclature:

Britain:	Astralite
France:	Astralite
Germany:	Astralit
Italy:	Astralite
Spain:	Astralita

b) Origin, Composition and Uses:

A type of Ammonium Nitrate dynamite, somewhat similar to Ammonite, containing as sensitizers TNT or DNT and sometimes a small amount of Nitroglycerin. Astralites were manufactured prior to WW II in Germany, Britain, and Italy by the Società Dinamite. Astralite 1, shown in Table 8, was used during WW I for filling Trench Mortars and Hand Grenades. The British are reported to have a composition similar to Astralite 4, except that 2.7% Guncotton is used in place of that amount of vegetable meal used in the German composition. Astralite is reported to be widely used in the USSR. It is suitable for use in rock blasting and in mining operations. See also AMMONITE.

TABLE 8

German Astralites

Composition (%) and Some Properties	Astralit 1	Astralit 2	Astralit 3	Astralit 4	Astralit O N
Ammonium Nitrate	84.5	80.0	79.0	68.3	80.0
TNT + DNT	7.0	12.0			-
Vegetable meal	1.0	3.0			-
TNT + DNT + meal	-	-	17.0	27.7	20.0
Charcoal	1.0	1.0			-
Paraffin oil	2.5	-	-	-	-
Nitroglycerin	4.0	4.0	4.0	4.0	-
Oxygen Balance, %	-	-	+2.5	-	+0.3
Trauzl Test, cc	-	-	390	-	375
Pb Block Crushing, mm	-	-	16.2	-	16.0
Sensitiveness to Initiation (requires)	-	-	No 1 Cap	-	No 3 Cap
Propagation in 30 cm Cartridges	-	-	12.0 cm	-	80cm
Velocity of Detonation, m/sec	-	-	5400	-	4900
Density of Cartridge, gm/cc	-	-	1.09	-	1.03
Heat of Explosion, kcal/kg	-	-	957.	-	1006
Temperature of Explosion, ^{o}C	-	-	2170	-	2220

AT or A

Russian abbreviation for Amatol.

AVIGLIANA 3 or NITAMITE

Italian Ammonal. See Nitramite under Italian Explosives.

AZIDA de PLOMO

Spanish for Lead Azide.

AZIDE de PLOMB or AZOTURE de PLOMB

French for Lead Azide.

AZIDO-TENEROSSOVAYA (detonator cap composition)

A Soviet multilayer initiating composition used in detonator caps. There is no corresponding US mixture currently used. See under Soviet Explosives.

AZID SVINTSA

Russian for Lead Azide.

AZOTIDRATO d'ARGENTO or
AZOTIDRURO d'ARGENTO

Italian for Silver Azide.

AZOTIDRATO di PIOMBO or
AZOTIDRURO di PIOMBO

Italian for Lead Azide.

AZOTNOKISLYI AMMONII

Russian for Ammonium Nitrate.

AZOTURE de PLOMB

Belgian for Lead Azide.

B4 (INCENDIARY or TYPE 2 (EXPLOSIVE) (incendiary charge)

A Japanese castable incendiary filler. There is no corresponding US composition. See under Japanese Explosives.

BAKUFUN (priming composition)

A Japanese Mercury Fulminate composition also called "Exploding Powder". It is similar to some mixtures used by the Germans & Italians. Priming compositions containing Mercury Fulminate are used by the US only to a limited extent because of their relative poor stability. See under Japanese Explosives.

BAKUHATSU-SEI ZERATIN (or ZERACHIN)

Japanese Blasting Gelatin.

BALISTITE

Italian Propellant used during WW II as a bursting charge in some shells. See Balistite under Italian Explosives.

BARATOL (bursting charge)

a) Foreign Nomenclature:

Britain:	Baratol
France:	Baratol
Spain:	Baratol

b) Origin:

Baratol was developed during WW I by the British.

c) Identifying Features, Chemical Composition & Properties:

Baratol is a light-yellow mixture of barium nitrate & TNT, in proportions which may be varied to meet the required purpose. The usual compositions are 73/27 & 67/33 barium nitrate/TNT. This explosive can be cast loaded. Its explosion temperature is 385°C, it is less sensitive to impact than TNT, about 56% as brisant as TNT, and is nonhygroscopic.

d) Manufacturing Process:

Barium nitrate, heated to about 90°C, is added to molten TNT in a melting kettle equipped with an agitator. The mixture is agitated until uniform and then cast at the lowest practical temperature.

e) Uses:

Baratol is used as a bursting charge in Bombs, and has been used as a burster in some Pyrotechnics.

BELAYA SMES'

A Soviet percussion-type initiating mixture. This name is translated as "White Composition". There is no corresponding US composition. See under Soviet Explosives.

BELIT

Russian for Bellite.

BELLITE (mining explosive)

Bellites are commercial high explosives based on Ammonium Nitrate. They are used primarily for coal mining in Europe & in the Soviet Union. See Bellite under French Explosives, and Belit under Soviet Explosives.

BERCLAVIT B (bursting explosive)

A German aluminized Ammonium Nitrate bursting charge. There is no corresponding US composition. See under German Explosives.

BICARBITE (mining explosive)

A current Belgian mining explosive developed and manufactured in Belgium. There is no corresponding US composition. See under Belgian Explosives.

BIKARBIT (blasting & coal mining explosive)

A German permissible explosive. There is no corresponding US composition. See under German Explosives.

BITTERSÄURE

German for Picric Acid.

BLACK POWDER (priming, igniting & blasting explosive)

a) Foreign Nomenclature:

Belgium:	Poudre noire
France:	Poudre noire
Germany:	Schwarzpulver
Hungary:	Fekete lőpor
Italy:	Polvere nera & Polvere da fuoco
Japan:	Kokoshokuyaku & Yuenyaku
Soviet Union:	Chörnyi porokh & Dymnyi porokh
Spain:	Pólvora negra
Sweden:	Svartkrut
Switzerland:	Amidogène & Schwarzpulver

b) Origin:

The exact date of the discovery of Black Powder is unknown. It is the oldest explosive & propellant known. Historians attribute its discovery to the Chinese, Hindus & Arabs. The Greeks used it during the 7th century. Marcus Graecus, in the 9th century, and Roger Bacon, in the 13th century, described compositions similar to the present Black Powder. For over 400 years the composition of Black Powder has remained unchanged with respect to the proportionality of its ingredients.

c) Identifying Features:

In appearance, Black Powder varies from a black, very fine powder to dense pellets which may be black or grayish-black because of a graphite-glazed surface.

d) Chemical Composition:

The composition of current military Black Powders is between the following limits: Potassium nitrate 74-78%, charcoal 12-16% & sulfur 10-12.5%. When sodium nitrate is used, the proportions of the ingredients are changed somewhat as follows: Sodium nitrate 72 $\pm$ 2%, charcoal 16 $\pm$ 2% & sulfur 12 $\pm$ 2%.

e) Physical Properties:

Military Black Powder is manufactured in a wide range of grain sizes, each of which is designated by a grade, symbol or name. That used in the loading of time-train Fuses may be of such a granulation that 97% passes thru a No 140 sieve. The particle density of Black Powder pressed at 25,000 lbs/sq in is 1.72 -1.77 gm/cc. At pressures up to 75,000 lbs/sq in, this value is increased to 1.88 gm/cc.

f) Test Methods and Explosive Characteristics:

The rate of burning of Black Powder depends on its composition, density & grain size. When confined, the burning rate is increased because of an increase in gas pressure. Black Powder will ignite at 425°C in 5 seconds. It is less sensitive to impact than Tetryl, but highly sensitive to friction & heat. It is about 50% as powerful as TNT.

g) Manufacturing Processes:

Black Powder is manufactured by pulverizing charcoal & sulfur together in a ball mill. The material, dampened by water, is mixed with finely ground nitrate and the moisture content is adjusted to 4%. The product is placed in a wheel mill and milled for several hours to increase the degree of incorporation. The milled material is pressed, at 6000 lbs/sq in, into cakes which are broken up by rollers to the desired grain size. If the powder is to be glazed, graphite is added during tumbling in a rotating drum of hard wood. After blending for 8 hours, the dried powder is separated into standard grain sizes by sieving, and packed in metal drums holding 20-25 pounds.

h) Safety Hazards:

The manufacture of Black Powder is quite hazardous because of its high sensitivity to ignition by friction, heat, spark or electrostatic discharge. Its high degree of accidental explosion hazard is attributable to these properties. All operations involving Black Powder are conducted by remote control in widely separated buildings.

i) Inspection Procedures:

Since Black Powder deteriorates due to absorption of moisture and since the containers in which it is stored are subject to rust, a thorough inspection of both the powder & container should be made once a year. One or several containers from each lot of powder should be opened at the time of inspection and if there is any doubt as to the serviceability of the powder, it should be sent to the laboratory for physical & chemical testing. At the same time, the containers should be examined for holes or corroded spots. Any damaged containers should not be repaired but removed from further use as storage containers. The contents of such containers should be transferred to new containers.

j) Preservation and Special Handling Requirements:

Black Powder is undesirably hygroscopic, this being due even more to the charcoal than to the nitrate. While the presence of moisture does not cause Black Powder to become unstable, the presence of moisture does cause it to react with and corrode metals such as steel, brass & copper. When used for military purposes, Black Powder is required to contain not more than 0.7% moisture, and generally it is dried to contain only 0.2-0.3% moisture. Because of its extreme sensitivity to initiation by spark and its great hygroscopicity, Black Powder should be packed in airtight steel drums containing not more than 25 pounds.

k) Storage:

In the absence of moisture, Black Powder is of a high order of stability, its ingredients being nonreactive even at 120°C. Black Powder containers must not be opened or stored in any magazine in which high explosives or loaded ammunition are stored. The containers should be stored in bullet-proof magazines but never in barracks, general supply rooms, inhabited buildings, or in any building heated by stoves or open fires. For purposes of quantity-distance storage and compatibility group storage, Black Powder is a Class 9, Group O explosive.

l) Demilitarization and/or Disposal Procedures:

If the Black Powder to be destroyed is in containers, they should be opened with wooden or non-sparking metal tools. If a stream or large body of water is at hand, the powder can be dumped into it. If this method cannot be used or anti-pollution laws prevent its use, the powder must be sent to the burning ground to be destroyed. At the burning ground the powder is spread in 2" wide strips, not over 2" deep, and in a trail no part of which parallels another part within a distance of 10 feet. Then lay a train of combustible material (such as paper or excelsior), prefirably on the down-wind side of the trail, of such a length that the operator can reach a safe place after igniting the paper. If sufficient space permits, use a new area of ground for each container of Black Powder. Never burn more than one container of Black Powder (50-lb maximum) at a time.

m) Uses:

Black Powder is used as a Sporting Propellant, blasting explosive, in Time Fuzes, Primers, Igniters, Delay & Relay elements, Pyrotechnics, the base charge for Shrapnel Shells, bursting charge for Blank, Saluting & Practice Shells, in chemical ammunition, and as an igniter in some Rockets and missiles.

BLACK POWDER FUSE

See Ogneprovodnyi shnur under Soviet Explosives.

BLASTIN

Swedish Cheddite-type blasting explosive.

BLASTING CAP CHARGES

See Detonatoren- und Sprengkapseln-Ladungen under German Explosives.

BLASTING GELATIN (dynamite)

a) Foreign Nomenclature:

France:	Dynamite gomme
Germany:	Sprenggelatine
Hungary:	Robbanó-zselatin
Italy:	Gelatina esplodente & Gelatina gomma
Japan:	Bakuhatsu-Sei Zeratin, Matsu & Sakura Nos 1 & 2
Soviet Union:	Gremuchii studen'
Spain:	Dinamita goma, Goma,
Sweden:	Spranggelatin
Switzerland:	Spezialsprenggelatine

b) Origin:

Blasting Gelatin was invented by Nobel in 1875. He found that 7-8% of Collodion Cotton dissolved in Nitroglycerin converted it into a stiff jelly which was a powerful explosive.

c) Characteristics:

Blasting Gelatin is a yellow, translucent, soft, elastic explosive. It is less sensitive to shock, friction & impact than either Nitroglycerin or Guhr Dynamite. It is completely insensitive to water and far more difficult to freeze than Guhr Dynamite. However, when frozen, Blasting Gelatin increases markedly in its sensitivity. At ordinary temperatures, it is completely stable but rapid temperature changes cause the Nitroglycerin to exude, resulting in increased sensitivity. Blasting Gelatin is difficult to detonate at normal temperatures, the higher Nitrocellulose content being more difficult to initiate.

d) Manufacturing Processes:

Blasting Gelatin is prepared by gelatinizing 92-93% Nitroglycerin with 8-7% Collodion Cotton (11.1-12.5% Nitrogen), either by warming the ingredients to 60-70°C in a water-jacketed vessel, or by adding solvents such as acetone or ether-alcohol to facilitate the gelatinization process. About 0.2% calcium carbonate is usually added as an antiacid agent. The finished product may contain up to 0.3% moisture. It is then placed into cartridges by means of a screw machine.

e) Storage:

Blasting Gelatin, in storage, progressively hardens with age and this is accompanied by a dimunition in sensitivity to initiation and by a considerable decrease in power. If stored for a long time, this explosive may even misfire. Such a material can be "revived" by heating it on a water bath to 60-70°C and cooling. Another method consists of prolonged rolling of the cartridges on a flat surface. The phenomenon of the stiffening of Blasting Gelatin during prolonged storage is not yet fully understood, but some theories have been advanced.

f) Uses:

Blasting Gelatin is one of the most powerful commercial explosives ever invented. Because of its high brisance, Blasting Gelatin is particularly suitable for blasting hard rock. It is also excellent for use in underwater blasting operations due to its waterproof nature.

F) Uses (cont'd):

See the above entries under the countries indicated for additional information, and also GELATINE DYNAMITE & DYNAMITE.

BLEIAZID

German and Swiss for Lead Azide.

BLEIPIKRAT

German for Lead Picrate.

BLEISTYPNAT or BLEITRINITRORESORCINAT

German or Swiss for Lead Styphnate.

BLYAZID (BLYACID)

Swedish for Lead Azide.

BLYSTYFNAT or BLYTRINITRORESORCINAT

Swedish for Lead Styphnate.

BM (Esplosivo)

Italian mining explosive.

BONIT

Swedish trade name applied to RDX/TNT mixtures which correspond to US Cyclotols.

BONOCORD

Swedish trade name for Detonating Fuse or Primacord.

BOOSTER

See Relais (Explosif pour) under French Explosives.

BRANDBOMBEN & BRANSATZE or BRANDSTOFFE

Names used in Germany and in Switzerland for Incendiary Compositions.

BROWN POWDER (delay composition & substitute Black Powder)

a) Foreign Nomenclature:

France:	Poudre brune
Germany:	Braunpulver
Italy:	Polvere bruna & Polvere cioccolata
Japan:	Kasshokuyaku
Soviet Union:	Buryi porokh & Shokoladnyi porokh

b) Origin:

The introduction of a slow-burning powder, known as Brown, Cocoa, or Chocolate Powder and representing a modification of Black Powder, was invented in Germany about 1882. It contained potassium nitrate 79%, brown charcoal (containing 2% water) 18% & sulfur 3%. The brown charcoal was prepared by incompletely charring a light wood or straw. This charcoal contains more volatiles than black charcoal. The composition of Brown Powder was kept secret until the Russians published, in 1866, the formula of their own powder manufactured at the Ochta plant near St Petersburg. Russian Brown Powder consisted of potassium nitrate 78.4%, brown charcoal (from incompletely charred rye straw) 19.6% & sulfur 2.0%.

c) Manufacturing Processes:

Brown Powder is manufactured in the same manner as Black Powder. The use of partially charred wood or straw, which possesses some collodial properties, enables the composition to flow under pressure, thus cementing the grains together as does the sulfur. This property of brown charcoal makes possible a reduction in the amount of sulfur required in the composition, thus making the powder slow burning.

d) Uses:

Brown Powder was formerly used as a Propellant in big guns. It greatly improved their ballistics and made possible the use of larger caliber guns than could be used with Black Powder. For equal muzzle velocities, Brown Powder produces less pressure in the gun than Black Powder.

d) Uses:

At present Brown Powder is used in some countries as a Delay Composition, and as a substitute for Black Powder where slow-burning powder is suitable.

See also the above entries under the country indicated.

BRUGÈRE POUDRE (explosive mixture)

An explosive mixture used by the French as a substitute for Black Powder. See under French Explosives. There is no corresponding US composition. The British use a similar mixture called Abel Powder or Picric Powder.

BURYI POROKH or SHOKOLADNYI POROKH

Soviet Brown Powder similar in composition to Soviet Black Powder, except that partially burned wood or straw is used instead of black charcoal. See under Soviet Explosives.

C6 (bursting charge)

A German castable bursting charge used as a substitute for TNT. There is no corresponding US composition. See under German Explosives.

CADINITE (mining explosive)

An Italian industrial mining explosive. This composition is similar to US 30% Gelatin Dynamite. See under Italian Explosives.

CAHÜCIT (blasting explosive)

A German safety blasting explosive. Similar Dynamites are used in England & France. See under German Explosives.

CALCINIT (mining explosive)

A German mining explosive based on calcium nitrate. There is no corresponding US composition. See under German Explosives.

CALORITE FRANÇAISE (pyrotechnic)

A French Incendiary Pyrotechnic mixture ignited by a fuse. There is no corresponding US composition. See under French Explosives.

CARBONIT (blasting & mining explosive)

A class of German permissible explosives. They are also used in England & France. See under German Explosives.

CELLAMITE (dynamite)

A French Ammonium Nitrate Dynamite. There is no corresponding US composition. See under French Explosives.

CELLULOSENITRAT, NITROCELLULOSE or NITROZELLULOSE

Names used in Switzerland for Nitrocellulose.

CENTRALITE RII & TA (permissible mining explosives)

Belgian permissible mining explosives. There are no corresponding US compositions. See under Belgian Explosives.

CHAKATSUYAKU, SANSHŌKI TORUŌRU or TYPE 92 (Navy)

Japanese for TNT.

CHANAYAKU (main high explosive charge)

A Japanese castable main charge for projectiles. There is no corresponding US composition. See under Japanese Explosives.

CHAŌYAKU (bursting charge)

A Japanese cast- or press-loaded charge for bombs. There is no corresponding US composition since Picric Acid has been replaced by Ammonium Picrate. See under Japanese Explosives.

CHARBRITE (mining explosive)

A current Belgian dynamite developed and manufactured in Belgium. There is no corresponding US composition. See under Belgian Explosives.

CHAUYAKU

Japanese for Cyclotol.

CHEDDIT

German for Cheddite.

CHEDDITE & CHEDDITE-TYPE EXPLOSIVES (blasting & demolition explosives)

a) Foreign Nomenclature:

Belgium:	Cheddite & Yonckite
France:	Cheddite, Explosif O, Explosif du Type OC, Explosif P, Explosif Street, Kaïpinite & Poudre Verte
Germany:	Cheddit, Alkalsit, Chloratit, Chloratsprengstoffe, Leonit, Miedziankit, Perchloratit & Perchloratsprengstoffe
Italy:	Cheddite, Cremonite, Explosivo P, Esplosivo S, Esplosivo speciale, Polvere "Cannel", Polvere verde & Romite
Japan:	Entoyaku
Soviet Union:	Shedit
Spain:	Chedita, Cheddita & Explosivo cloratado
Sweden:	Cheddite, Blastin & Territ,
Switzerland:	Cheddit & Pierrit

b) Origin:

Explosives known as Cheddites were invented in France in 1897 by E. Street who patented several varieties of the original composition. At about the same time the Chemische Fabrik Griesheim in Germany patented a similar type explosive. The manufacture of these explosives under the name of

b) Origin (cont'd):

"Explosifs Street" began in 1898 by the Société Bergès, Corbin et Cie at Chedde, Haute Savoie, France. Certain varieties of these explosives were admitted to Belgium. They were also exported to England where they have been produced since 1900 under the name of "Cheddites", so called because they were manufactured at Chedde.

c) Characteristics:

Cheddites are special types of Chlorate or Perchlorate Explosives in which the grains are coated with liquid or plastic materials in order to render them less hygroscopic & less sensitive to initiation by mechanical action. Cheddites may be subdivided into nongelatin & gelatin types. The nongelatin-type Cheddites are in the form of soft grains, white or yellow in color unless they have been artificially colored in order to distinguish one type from another. They are readily compressible but their density must be carefully controlled (1.3-1.4 gm/cc). These Cheddites are relatively insensitive to shock & friction at normal temperatures. They burn rapidly, when unconfined, without any tendency to explode.

Gelatin-type Cheddites are plastic explosives which do not harden in storage. They were developed in 1911 by C. Rubins and manufactured by the Cheddit & Dynamit AG, Liestal, Switzerland, and then in other countries. These explosives have a higher brisance than Ammonium Nitrate explosives.

See also Tables 9 & 10.

d) Manufacturing Processes:

In preparing non-gelatinized Cheddites, one or more of the explosive compounds used in the composition are dissolved in a heavy oily substance by heating the mixture in a steam-jacketed, enamelled iron pan at 65-80°C. When the mass becomes homogeneous, it is cooled to 55°C, and the preheated, finely pulverized chlorate or perchlorate is gradually introduced while stirring the mixture.

d) Manufacturing Processes (cont'd):

As soon as the particles are uniformly coated, the slurry is poured onto a flat wooden surface and rolled into a thin layer. The solid mass is then broken by means of a wooden roller into small grains which are pressed into paper cartridges. Cartridges containing Sodium Chlorate in the composition should be dipped into molten paraffin or wax in order to render them nonhygroscopic.

For gelatinized-type Cheddites, the nitrocompounds are mixed witn Nitrocellulose & nitroglycerin and heated to 40°C until the mass is uniform. Then the finely powdered chlorate or perchlorate is added and coating of the grains is conducted by stirring, but without raising the temperature above 40°C.

e) Uses:

Cheddites were originally developed for use as industrial blasting & demolition explosives. Gelatin-type Cheddites are very effective for work in galleries, especially with humid rocks that are not too hard. Some Cheddites were used during WW I for military purposes such as in demolition work and as a bursting charge in Bombs, Grenades, Mortar Shells & Mines. Cheddites were also used during WW II for some military purposes. They are very much in use today in European countries for industrial purposes.

TABLE 9

Chlorate Cheddites

Composition and Some Properties	French 55 -CSE -1948	French 58 -CSE -1948	Italian Cheddites OS Extra	Italian Cheddites O Extra	Italian Cheddites O Extra B	Swiss & Ital Gelatin Cheddites Older	Swiss & Ital Gelatin Cheddites Newer	French Gelatin Cheddite n°18	Italian Plastigels I	Italian Plastigels II
Sodium Chlorate	74	74	90	79.0	82.6	75	70	74.0	72.0	72.0
DNT (liquid)	23	23	-	16.0 (liq)	-	23.8	23.5	19.0	19.7	19.7
Sawdust	-	3	-	-	-	-	-	-	-	-
Cork flour	3	-	-	-	-	-	-	-	-	-
Nitroglycerin	-	-	-	-	-	-	5.0	5.5	-	-
Collodion Cotton	-	-	-	-	-	1.2	1.5	1.5	1.8	1.8
Castor oil	-	-	-	5.0	-	-	-	-	-	-
Paraffin	-	-	7	-	5.0	-	-	-	-	-
Vaseline	-	-	3	-	2.4	-	-	-	-	-
PETN	-	-	-	-	-	-	-	-	-	6.5
TNT	-	-	-	-	10.0	-	-	-	6.5	-
Oxygen balance %	-	-	+6.08	+3.90	+4.32	-	-	-	+4.4	
Density, g/cc	-	-	ca 1	ca 1	ca 1	1.9	-	2.0	ca2	
Detonation rate, m/s	-	-	3000	3200	3200	-	-	-	3600	-
Power(PA 100%)	93	89	80	94	85	83	83	83	108	-
Impact test, cm, 2 kg	-	-	<18	28	<16	-	-	-	24	-

TABLE 10

Perchlorate Cheddites

Composition	French I	French II	French III	British Blastine	German Military	German Perchloratits 1	German Perchloratits 3	German Perchloratits 3	Swedish Territ	French Sevranites no 1	French Sevranites no2	Belgian Yonckite
Ammonium Perchlorate	82	50	89	60	-	-	-	-	43	31	42	43
Potassium Perchlorate	-	-	-	-	56	68	35	34	-	-	-	-
Ammonium Nitrate	-	-	-	-	-	10	42	48	-	-	-	-
Sodium nitrate	-	30	-	22	-	-	-	-	28	-	-	32
Mononitronaphthalene	-	-	-	-	12	1	-	-	-	-	-	-
Dinitrobenzene	-	-	-	-	32	-	-	-	-	-	-	-
DNT	13	15	-	-	-	16	14	12	27.8	-	-	-
TNT	-	-	-	11	-			-		-	-	15
Castor oil	5	5	-	-	-	-	-	-	-	-	-	-
Paraffin	-	-	11	7	-	-	-	-	-	-	-	-
Nitroglycerin	-	-	-	-	-	4	4	-	-	-	-	-
Collodion Cotton	-	-	-	-	-	-	-	-	1.2	-	-	-
Woodmeal	-	-	-	-	-	1	5	6	-	-	-	-
PETN	-	-	-	-	-	-	-	-	-	48	42	-
Plasticizer	-	-	-	-	-	-	-	-	-	18	16	-
Al powder	-	-	-	-	-	-	-	-	-	3	-	10

CHEDITA or CHEDDITA

Spanish for Cheddite. See Chedita under Spanish Explosives.

CHIKKAEN (Navy) or CHIKKA NAMARI (Army)

Japanese for Lead Azide.

CHLORATIT (blasting & demolition explosive)

A German Cheddite-type explosive. See under German Explosives.

CHLORATSPRENGSTOFFE

German Chlorate Explosives.

CHÖRNYI POROKH

Russian for Black Powder.

CICLONITA, EXÓGENO or T4

Spanish for RDX. See Exógeno under Spanish Explosives.

CLORAMITE (mining explosive)

An Italian mining explosive utilizing discarded military propellants. There is no corresponding US composition. See under Italian Explosives.

COLLODION or PYROXYLINE

French military grade Nitrocellulose.

COLODIO or PIROXILINA

Spanish for Nitrocellulose.

COMPOSITION A (booster & bursting charge)

a) Foreign Nomenclature:

Britain:	Composition A
France:	Hexogène/cire d'abeille
Germany:	Fullpulver Nrs 91-H5, H-10, H-10.3 & Nr (?) H-3
Japan:	Angayaku
Soviet Union:	Flegmatizirovannyi gheksoghen

b) Origin:

The British introduced, during WW II, an explosive composition consisting of RDX 91% & beeswax 9%. This is a highly brisant explosive and suitable for press loading. Subsequent changes in the US replaced beeswax with synthetic waxes, & changed the granulation of RDX and the method of manufacture. The US designation became Composition A-3. The explosive made by coating or desensitizing RDX with wax or other substances has been adopted by several foreign countries.

c) Characteristics:

Composition A is white to buff in color, the color depending upon the particular wax used, although the German composition was dyed blue & the Italian composition red. This explosive is completely stable and nonhygroscopic. It will explode when subjected to a temperature of 250°C for 5 seconds. It is shown by various tests to be considerably more powerful than TNT. Composition A should not be stored at temperatures above 75°C because of the possibility of softening the wax coating at this temperature.

d) Uses:

Composition A is suitable for use as a booster when small amounts of wax are used as a coating, and as a bursting charge if larger amounts of wax are used to coat the RDX crystals.

COMPOSITION B or CYCLOTOL, (bursting charge)

a) Foreign Nomenclature:

Belgium:	Hexolite
France:	Hexolite or HT
Germany:	Füllpulver No 18 & Füllpulver No 95
Italy:	Tritolite
Japan:	Chauyaku & Nigotanoyaku Mk 2
Spain:	Tritolita
Sweden:	Bonit & Hexotol

b) Origin:

Composition B was developed by the British between WW I & WW II when RDX became available in sufficient quantity for military use. Compositions consisting of mixtures of RDX & TNT in various proportions are called Cyclotols. When a desensitizing wax is added, the explosive is designated Composition B. Both explosives were adopted by the USA early in WW II. Many foreign countries have adopted similar mixtures as military explosives.

c) Characteristics:

Composition B is a yellow to brownish-yellow explosive which can be cast loaded to a density of 1.65 gm/cc. The explosion temperature value of Composition B is 275°C in 5 seconds. The solid explosive is slightly more sensitive than TNT but much less sensitive than RDX. It is 130% more brisant & powerful than TNT. Composition B is of satisfactory stability in storage, but after prolonged storage at elevated temperatures it undergoes slight exudation. At ordinary temperature, it causes slight corrosion of copper & brass, but does not affect aluminum, mild steel, stainless steel, nickel, cadmium or zinc. In the presence of moisture, Composition B causes some corrosion of cadmium & zinc.

d) Manufacturing Processes:

Composition B is manufactured from TNT & water-wet RDX. The TNT is melted in a steam-jacketed melting kettle equipped with a stirrer. The wet RDX is added slowly with stirring to the molten TNT at 100°C. Heating & stirring are continued until all moisture is evaporated.

d) Manufacturing Processes (cont'd):

Wax is then added. The nature of the wax is important since only certain waxes do not tend to segregate on cooling. When the composition is thoroughly mixed, it is cooled to a satisfactory pouring temperature. Composition B is cast directly into ammunition components, or so as to form chips which can be stored or shipped for use elsewhere.

e) Uses:

Composition B is used by all countries as a bursting charge in ammunition. Cyclotols also find application in ammunition but, being distinctly more sensitive than Composition B, it is not used in Bombs or other ammunition which must first penetrate a target before detonation.

COMPOSITION C & COMPOSITION C-TYPE PLASTIC EXPLOSIVES (demolition explosives):

a) Foreign Nomenclature:

Britain:	PE (Plastic Explosive) 1, 2, 3 & 3A
France:	Explosifs plastiques PE 1 & PE 3A
Germany:	Hexoplast 75 & Plastit
Italy:	T4 (plastico)
Japan:	Koshitsu, Oshitsuyaku & Shouyaku Koshitsu
Spain:	Exógeno plastico, PE & Plastex

b) Origin:

Composition C-type plastic explosives were originally developed in Britain during WW II to provide a demolition charge which could be shaped by hand. The mixtures are based on RDX with either nonexplosive or explosive plasticizers added to make a stable moldable charge. Explosives of this type were standardized in the US during WW II, and further improvements in plastic explosives of this type have been made since WW II.

c) Chemical Composition:

The standard US composition, designated Composition C consists of RDX 88.3%, nonexplosive

c) Chemical Composition (cont'd):

oily plasticizer 11.1% & lecithin 0.6%. Lecithin was added to help prevent the formation of large crystals of RDX which would increase the sensitivity of the composition.

This was replaced by Composition C-2 which consists of RDX 80% & explosive plasticizer 20%. The explosive plasticizer was composed of a liquid mixture of mononitrotoluene, Dinitrotoluene, TNT, Nitrocellulose & dimethylformamide.

A further replacement, designated Composition C-3, consists of RDX 77% & explosive plasticizer 23%. This plasticizer contains mononitrotoluene, Dinitrotoluene, TNT, Tetryl & Nitrocellulose.

The improved plastic explosive is designated Composition C-4 or Harrisite. It contains RDX 91.0%, polyisobutylene 2.1%, motor oil 1.6% & di-(2-ethylhexyl) sebacate 5.3%.

d) Characteristics:

Composition C is a white to brown explosive which, while plastic from 0° to 40°C, becomes brittle & less sensitive below 0°C, and tends to become gummy & exude oil at temperatures above 40°C. This explosive is less effective than Composition B but more efficient than TNT as a bursting charge.

Composition C-2 is white to yellow-brown. It is plastic from -30°C to 52°C but becomes less plastic in storage at higher temperatures due to evaporation of the volatile components. This explosive is slightly more sensitive & effective than Composition C.

Composition C-3 is a yellowish putty-like solid that has a density of 1.60 gm/cc. It is more brisant than TNT, but less brisant than Tetryl. Its sensitivity to impact is similar to that of TNT, but much less than that of RDX. Composition C-3 is pliable at normal temperature and can be easily molded, but at -29°C it becomes hard & brittle, and undergoes considerable exudation when stored at 77°C.

d) Characteristics (cont'd):

Composition C-4 is white to light brown in color. Its explosion temperature is 290°C in 5 seconds. It is less sensitive to impact & more brisant than Composition C-3. Composition C-4 is stable & essentially nonhygroscopic. It will not harden at -57°C and will not exude at 77°C.

e) Manufacturing Processes:

In the manufacture of Composition C-3, the plasticizing agents are mixed together in a steam-jacketed melting kettle, equipped with a stirrer, and heated to near 100°C. Water-wet RDX is added slowly, and heating & stirring are continued until the mixture is uniform & all the water has been removed.

In the manufacture of Composition C-4, the polyisobutylene-plasticizer, previously made up in ether, is mixed with 44-micron size RDX either by hand kneading & rolling, or in a Schrader Bowl mixer. The thoroughly blended explosive is dried in air at 60°C and loosely packed by hand tamping, to its maximum density, into Demolition Blocks or in special ammunition items.

f) Uses:

Composition C-type plastic explosives are used primarily as Demolition Blocks by several countries. Some of these explosives are particularly suitable for underwater demolition purposes if they are properly packaged or formulated so that their efficiency is not impaired by immersion in water. Composition C-4 is ideally suited for cutting thru steel because of its ability to be hand molded because of its high rate of detonation.

COMPOSITION d'AMORÇAGE

French Priming or Initiating Composition. See Explosif d'amorcage under French Explosives.

COMPOSITIONS INCENDIARIES

French incendiary compositions.

COMPOSIZIONE INNESCANTE or COMPOSIZIONE PRIMARIA

Italian Initiating & Priming Composition.

COMPOSIZIONE TRACCIANTE

Italian Tracer Composition.

COOPPALITE (permissible coal mining explosive)

A current Belgian dynamite developed and manufactured in Belgium. There is no oorresponding US composition. See under Belgian Explosives.

CORDEAU DÉTONANT

French Detonating Cord or Primacord.

COTONE FULMINANTE or FULMICOTONE

Italian for Guncotton.

COTON-POUDRE

French for military grade Nitrocellulose. Also Belgian.

CREMONITE (mining explosive)

An Italian Cheddite-type explosive. There is no corresponding US composition. See under Italian Explosives.

CRESILITE

Italian for Cresylite or 2,4,6-Trinitro-m-cresol.

CRÉSYLITE

French for Cresylite or 2,4,6-Trinitro-m-cresol.

CSE (Explosif)

French high-explosive composition developed or approved by the Commission des Substances Explosives.

CYANURIC TRIAZIDE

See Cyanurtriazid under Swiss Explosives.

CYCLONITE

See RDX.

CYCLOTETRAMÉTHYLÈNETETRANITRAMINE or OCTOGÈNE

French for HMX.

CYCLOTOL

See COMPOSITION B.

CYCLOTRIMÉTHYLENETRINITRAMINE or HEXOGÈNE

French for RDX. See Hexogène under French Explosives.

CYCLOTRIMÉTHYLENETRINITROSAMINE

French for R-Salt.

DAINAMAITO

Japanese for Dynamite.

DBX

Code name for Depth Bomb Explosive. See Minolex under Spanish Explosives.

DD (Explosif)

The name applied to a series of French high explosives. See under French Explosives. These compositions are similar to British Shellite, Italian MBT & Tridite.

DEMOLITION EXPLOSIVES

See Sprängamnen med Minverkan under Swedish Explosives.

DETONATEUR ELECTRIQUE

French for Electric Detonator.

DETONATING FUSE or PRIMACORD

See Detoniruyoushchii shnur under Soviet Explosives, Bonocord under Swedish Explosives, and Detonierende Zündschnur or Knallzündschnur under Swiss Explosives.

DETONATOR CAPS

See Kapsiuli detonatory under Soviet Explosives.

DETONATOREN- und SPRENGKAPSELN-LADUNGEN

German Detonator & Blasting Cap Charges.

DETONIERENDE ZÜNDSCHNUR or KNALLZÜNDSCHNUR

Name used in Switzerland for Detonating Fuse or Primacord.

DETONIRUYOUSHCHII SHNUR

Russian for Detonating Fuse or Primacord.

DIAMIN or PH-SALZ

German for Ethylenediamine Dinitrate.

DIETHYLENEGLYCOL DINITRATE

See Nitrodiglicole or Nitroeterolo under Italian Explosives.

DIMETHYLAMMONIUM NITRATE

See DI-Salz under German Explosives.

DINAFTALIT, ZERNËNYI

Russian for Schneiderite.

DINAMIT

Russian for Dynamite.

DINAMITA

Spanish for Dynamite.

DINAMITE

Italian for Dynamite.

DINAMON

Italian, Soviet & Spanish Ammonium Nitrate Dynamite.

DINITRATE de DIOXYÉTHYLDINITROÖXAMIDE

French for a high-explosive compound abbreviated NENO for Nitrated Ethyl Nitro Oxamide. See under French Explosives.

DINITROXYDIÉTHYLNITRAMINE

French for a high explosive compound abbreviated DINA for Diethanolnitramine Dinitrate. See under French Explosives.

p-DIPICRILAMMINA

Italian for Hexanitrodiphenylamine. See Esanitro-difenilammina under Italian Explosives.

DI-SALZ

German for Dimethylammonium Nitrate.

DONARIT (dynamite)

A German Ammonium Nitrate Dynamite. See under German Explosives.

DONARITA (dynamite)

Spanish Ammonium Nitrate Dynamite. See under Spanish Explosives.

DRIP OIL

See Olio di sgocciolamento under Italian Explosives.

DYNAMIT

German & Swedish for Dynamite. This name is also used in Switzerland for Dynamite.

DYNAMITE & DYNAMITE-TYPE EXPLOSIVES (blasting explosives)

a) Foreign Nomenclature:

Belgium:	Arionite, Bicarbite, Charbrite, Cooppalite, Dynamite III & Sécurite
France:	Cellamite, Dynamite, Dynamite O, Dynamite pulvérulente, Explosif de mine, Grisoudynamite, Grisounaphthalite, Grisoutétrylite, Poudre de mine & Poudre Favier
Germany:	Albit, Astralit, Bikarbit, Calcinit, Carbonit, Dynamit, Guhrdynamit, Extracarbonit, Gesteinssprengstoffe, Kohlensprengstoffe, Nitrobaronit, Romperit 1, Sicherheitsdynamit, Westfalit & Wettersprengstoff
Hungary:	Dinamit
Italy:	BM (Esplosivo), Cadinite, Cloramite, Dinamite, Esplosivo da mina & Tipo I & II dinamite.
Soviet Union:	Dainamaito & Sakuma Dainamaito Dinamit, Grisutin, Plasticheskii dinamit, Pobedit
Spain:	Dinamita
Sweden:	Dynamit
Switzerland:	Dynamit, Plastolit, Sicherheitssprengstoffe, Simplonit & Vergé Explosivstoffe

b) Origin:

Alfred Nobel, Swedish chemist, gave the name Dynamite (1867) to his invention of the explosive obtained by mixing Nitroglycerin with kieselguhr. The strength of the Dynamite was indicated by the percentage of Nitroglycerin in the mixture. Later it was found by Nobel (1869) that even stronger Dynamites could be made by substituting sodium nitrate (or other nitrate) and a combustible absorbent, such as woodpulp, for the kieselguhr.

b) Origin (cont'd):

The resulting composition was called "Dynamite with an active base".

The term "Dynamite" has both a general and a specific meaning today. As a general term, it is used to refer to all mixtures given above, as examples of compositions (or names) used by various countries. As a specific term, it is used as an alternate reference to "straight Dynamite" which includes "Dynamites with inactive base" and "Dynamites with active base".

c) Composition & Characteristics:

All Dynamites, except some military Dynamites, contain Nitroglycerin plus varying combinations of absorbents, oxidizers, antacids & freezing-point depressants. Today Dynamites are grouped into the following basic types:

Blasting Gelatin See entry in this section.

Gelatin Dynamite See entry in this section.

Low-Freezing & Non-Freezing Dynamite

Military Dynamite

Permissible Dynamite

Straight Dynamite

Low-Freezing & Non-Freezing Dynamites are similar in composition to Gelatin Dynamite (qv) but include an ingredient which will lower the tendency of the Nitroglycerin explosive to freeze. As in the case of other Dynamites, some Low-Freezing & Non-Freezing Dynamites may contain Ammonium Nitrate. Liquid Dinitrotoluene is often used in Low-Freezing Dynamite. Several ingredients may be used to render compositions non-freezing. These include dinitrochlorohydrin, nitrated products of glycerin & nitrates of glycol. Low-Freezing Dynamites usually freeze near 0°C and thus are suitable for exposure only in moderate winter weather. Non-Freezing Dynamites can be subjected to temperatures to -30°C without freezing.

Military Dynamites may be of the same compositions as Dynamites used in industrial & commercial operations. However, some Military

c) Composition & Characteristics (cont'd):

Dynamites are designed for specific blasting & demolition work. Unlike commercial Dynamite, some Military Dynamites contain no Nitroglycerin. These compositions will not freeze in cold storage and will not exude in hot storage. They are less sensitive to friction & impact than are commercial Dynamites, and can be handled, transported & stored with relative safety.

Permissible Dynamites or Safety Explosives usually contain Ammonium Nitrate which is sensitized with Nitrocellulose or gelatinized Nitroglycerin. Small amounts of "cooling" material, such as sodium nitrate or sodium chloride may be added. In some countries, ingredients such as Ammonium Nitrate & Nitroglycerin have been replaced by other explosives with satisfactory results. See also Ammonium Nitrate Dynamite.

Straight Dynamites with inactive base are reddish yellow to brownish yellow. They are almost white when frozen. Normally they will freeze at 10°C. At normal temperatures, these Dynamites resemble fresh earth in that they are a crumbly plastic mass. Their sensitivity to shock & friction is less than that of Nitroglycerin, and they are less brisant. However, Straight Dynamites are more sensitive than other types of Dynamites, and they will detonate when hit by a rifle bullet. Straight Dynamites with active base are greasy powders which are loose & moist. The Ammonia (Ammonium Nitrate) Dynamites are especially strong but are hygroscopic, as are the sodium nitrate types. Otherwise, these Dynamites are similar in characteristics to those with inactive base.

d) Uses:

Low-Freezing & Non-Freezing Dynamites are used for all types of blasting & mining operations where low temperatures are likely to freeze ordinary Dynamites.

Military Dynamites are used for blasting & demolition work.

d) Uses (cont'd):

Permissible Dynamites are used universally for the mining of coal where the accumulation of "fire damp" (methane gas-air mixtures) & coal dust-air mixtures may be ignited by high-detonation temperature explosives. Nongelatinous Permissible Dynamites are used in mines that are relatively dry; gelatinous Permissible Dynamites are better adapted for use in wet mines. Both types are designed especially for blasting rock in coal mines.

Straight Dynamites are fast & shattering when they are detonated. They are used, therefore, where a "quick" explosive is desired. Such uses include underwater blasting, steel demolition & the priming of Blasting Gelatin.

Dynamites with inactive base are practically non-existent in the USA. They have been replaced by active-base types and are used only as a basis of comparison for other types of Dynamites.

"E" (EXPLOSIVE) (bursting charge)

A Japanese castable explosive charge. There is no corresponding US composition. See under Japanese Explosives.

ECHOS or ESCHO (bursting charge)

An Italian & French military explosive charge. This composition is reported to be used also in France. There is no corresponding US composition. See under Italian Explosives & under French Explosives.

ECRASITA

Spanish name for Ammonium Trinitrocresylate.

ECRASITE

Italian name for Ammonium Trinitrocresylate.

EDNA

An abbreviation for Ethylenedinitramine. See Éthylènedinitramine under French Explosives.

EKRASIT

Soviet name for Ammonium Trinitrocresylate.

ELEKTROZAPAL

Soviet Electric Primer.

ENERGIT

A German mining explosive.

ENNAYAKU (demolition charge)

A Japanese substitute demolition charge & substitute main charge. There is no corresponding US composition. See under Japanese Explosives.

ENTOYAKU (demolition charge)

A Japanese substitute demolition charge & substitute main charge. This is a Cheddite-type explosive mixture. See under Japanese Explosives.

ERSATZSPRENGSTOFFE

German substitute explosives.

E-SALZ

One of several German names for RDX. See Hexogen under German Explosives.

ESANITRODIFENILAMMINA or EXIL

Italian for Hexanitrodiphenylamine.

ESANITROSORBITE

Italian for Hexanitrosorbitol.

ESCHO or ECHOS (bursting charge)

Italian & French military explosive. See Echos under Italian Explosives & under French Explosives.

EXPLOSIVI PLASTICHI

Italian plastic explosives.

ESPLOSIVO 60/40

Italian Amatol.

ESPLOSIVO 86/14

Italian Cheddite-type explosive.

ESPLOSIVO AMMISSIBILE, ESPLOSIVO ANTIGRISOUTOSI or ESPLOSIVO di SICUREZZA

Italian Permissible Explosive.

ESPLOSIVO ASN

See ASN Esplosivo under Italian Explosives.

ESPLOSIVO da GUERRA

Italian military explosive.

ESPLOSIVO da MINA

Italian mining explosive or Dynamite.

ESPLOSIVO di SICUREZZA

Italian Safety Explosive.

ESPLOSIVO FNP

See FNP Esplosivo under Italian Explosives.

ESPLOSIVO P (blasting explosive)

An Italian Cheddite-type blasting explosive. There is no corresponding US composition. See under Italian Explosives.

ESPLOSIVO PLASTICO (Demolition explosive)

An Italian plastic demolition explosive. There is no corresponding US composition. See under Italian Explosives.

ESPLOSIVO S (blasting explosive)

An Italian Cheddite-type blasting explosive. There is no corresponding US composition. See under Italian Explosives.

ESPLOSIVO S20 (blasting explosive)

An Italian Amatol-type main explosive charge. The composition is similar to the French Explosif du type N N^{o}0. See under Italian Explosives.

ESPLOSIVO SPECIALE

See Esplosivo P under Italian Explosives.

ETHLENEDIAMINE DINITRATE

See PH-Salz or Diamin under German Explosives.

ÉTHYLÈNEDINITRAMINE

French for a high explosive compound abbreviated EDNA. See under French Explosives.

EXIL, ESANITRODIFENILAMMINA or p-DIPICRILAMMINA

Italian for Hexanitrodiphenilamine. See Esanitrodifenilammina under Italian Explosives.

EXOGENE, T4 or TRIMETILENTRINITROAMMINA

Italian for RDX. See T4 under Italian Explosives.

EXÓGENO, CICLONITA or T4

Spanish for RDX. See Exógeno under Spanish Explosives.

EXÓGENO PLASTICO, PLASTIX or PE

Spanish for Composition C. See Exogeno plastico under Spanish Explosives.

EXPLOSIF ANTIGRISOUTEUX or EXPLOSIF de FAVIER

French Ammonium Nitrate Safety Explosive. See under French Explosives.

EXPLOSIF d'AMORÇAGE

French Priming & Initiating Compositions. See under French Explosives.

EXPLOSIF DD

French high explosive composition similar to British Shellite and Italian MBT & Tridite. See DD (Explosif) under French Explosives.

EXPLOSIF de MINE

French Mining Explosive.

EXPLOSIF de SÛRETÉ

French Safety Explosive. See Explosif antigrisouteux under French Explosives.

EXPLOSIF du TYPE N or EXPLOSIF NITRATÉ

French Nitrate Explosive. See CSE (Explosif) under French Explosives.

EXPLOSIF du TYPE O ou OC

French Chlorate Explosive. See Cheddite & CSE (Explosif) under French Explosives.

EXPLOSIF MDN or MDn

French castable Picric Acid composition. See MDN (Explosif) under French Explosives.

EXPLOSIF MDPC

French castable Picric Acid composition. See MDPC (Explosif) under French Explosives.

EXPLOSIF MMn

French castable Picric Acid composition. See MMn (Explosif) under French Explosives.

EXPLOSIF NITRATÉ or EXPLOSIF du TYPE N

French Ammonium Nitrate Safety Explosives. See under French Explosives.

EXPLOSIF NTMX

A French Ammonium Nitrate composition. See NTMX (Explosif) under French Explosives.

EXPLOSIF NX

A French Ammonium Nitrate composition. See NX (Explosif) under French Explosives.

EXPLOSIF P (mining explosive)

A French Cheddite-type mining explosive. There is no corresponding US composition. See under French Explosives.

EXPLOSIF PERCHLORATÉ

French Cheddite-type burster charge for ammunition. There is no corresponding US composition. See under French Explosives.

EXPLOSIF PLASTIQUE

A series of French Plastic Explosives developed since WW II. There are no corresponding US compositions. See under French Explosives.

EXPLOSIF (ou POUDRE) de l'ÉTAT FRANCAIS

A French high-temperature Explosive or Propellant composition. There is no corresponding US composition. See under French Explosives.

EXPLOSIF S

French Schneiderite. See under French Explosives.

EXPLOSIF STREET

French Cheddite. See under French Explosives.

EXPLOSIFS BRISANTS (blasting explosives)

A series of current industrial blasting explosives developed and manufactured in Belgium. See under Belgian Explosives.

EXPLOSIFS de FAVIER (permissible mining explosive)

Permissible Ammonium Nitrate explosives introduced in the 1880's but modified and improved since that time. These are commercial explosives used by several countries. See under Belgian Explosives & under French Explosives.

EXPLOSIFS SGP (mining explosives)

A class of Belgian blasting explosives permitted for use in coal mines. These commercial explosives are used by several countries. See under Belgian Explosives.

EXPLOSIVE D

See AMMONIUM PICRATE.

EXPLOSIVO CLORATADO

A Spanish Cheddite-type explosive.

EXPLOSIVOS PLASTICOS

Spanish for plastic explosives.

EXPLOSIVOS PRIMARIOS Y INICIADORES

Spanish Priming & Initiating Explosives.

EXTRACARBONIT (dynamite)

A German permissible Dynamite composition. See under German Explosives.

FACKELN or LEUCHTKUGELN

German for pyrotechnic flares. See Feuerwerkerei under German Explosives.

FEUERWERKEREI

German for Pyrotechnics.

FLAMMBOMBEN

German for Incendiary Bombs. See Brandstoffe or Brandsätze & Brandbomben under German Explosives for Incendiary Bomb Compositions.

FLAMMIVORE (blasting explosive)

A Current Belgian mining explosive developed and manufactured in Belgium. There is no corresponding US composition. See under Belgian Explosives.

FLEGMÄTISERAT SPRENGÄMNE

Swedish for Phlegmatized Explosives.

FLEGMATIZIROVANNYI GHEKSOGHEN

Russian for Phlegmatized or Desensitized RDX (Composition A).

FLEGMATIZIROVANNYI TEN

Russian for Phlegmatized or Desensitized PETN.

FLEGMATIZIROVANNYI TROTIL

Russian for Phlegmatized or Desensitized TNT.

FNP ESPLOSIVO (bursting charge)

An Italian high-explosive main charge for Shells. There is no corresponding US composition. See under Italian Explosives.

FÖRDIT (blasting explosive)

A class of German permissible Gelatin Dynamites. See under German Explosives.

FORCITE (blasting explosive)

A Belgian Gelatin Dynamite used in blasting & mining operations except in gaseous coal mines. The French used the same composition. See under Belgian Explosives and French Explosives.

FORCITE EXTRA (blasting explosive)

A French Ammonium Nitrate Safety Explosive. There is no corresponding US composition. See Explosif antigrisouteu under French Explosives.

FORMIT (bursting charge)

A German substitute explosive. There is no corresponding US composition. See under German explosives.

FORMULA 226 (blasting explosive)

A French Ammonium Nitrate blasting explosive. There is no corresponding US composition. See under French Explosives.

FORTEX (bursting charge & mining explosive)

A French Ammonium Nitrate military bursting charge, or mining explosive. There is no corresponding US composition. See under French Explosives.

FRACTORITE CA (mining explosive)

A current Belgian mining explosive developed and manufactured in Belgium. See under Belgian Explosives.

FRANTSUZSKAYA SMES' (bursting charge)

Soviet name for a so-called "French Mixture" of Picric Acid & Dinitronaphthalene. There is no corresponding US composition. See under Soviet Explosives.

FÜLLPULVER

German name for Amatol.

FÜLLPULVER or FÜLLUNG

German name for Explosive Filler.

FULMENIT (dynamite)

A German Favier-type Dynamite. See under German Explosives.

FULMICOTON

French for Guncotton.

FULMICOTÓN

Spanish for Guncotton.

FULMICOTONE or COTONE FULMINANTE

Italian for Guncotton.

FULMINATE de MERCURE

French for Mercury Fulminate. Also Belgian.

FULMINATO d'ARGENTO

Italian for Silver Fulminate.

FULMINATO de MERCURIO

Spanish for Mercury Fulminate.

FULMINATO di MERCURIO

Italian for Mercury Fulminate.

FUL'MINAT RTUTI or GREMUCHAYA RTUT'

Russian for Mercury Fulminate. See Gremuchaya rtut' under Soviet Explosives.

GAMSIT or GELATINE-GAMSIT

Names used in Switzerland for a class of Gelatin Dynamites.

GELATINA 40%

Italian Gelatin Dynamite. See Dinamite under Italian Explosives.

GELATINA DINAMITA

Spanish Gelatin Dynamite. See Dinamita under Spanish Explosives.

GELATINA DINAMITE

Italian Gelatin Dynamite. See Dinamite under Italian Explosives.

GELATINA DINAMITE INCONGELABILE (or ANTIGELO)

Italian Gelatin Dynamite. See Dinamite under Italian Explosives.

GELATINA ESPLODENTE or GELATINA GOMMA

Italian Gelatin Dynamite. See Dinamite under Italian Explosives.

GELATINA ESPLOSIVA da GUERRA

Italian Gelatin Dynamite. See Dinamite under Italian Explosives.

GELATINA GOMMA or GELATINA ESPLODENTE

Italian Gelatin Dynamite. See Dinamite under Italian Explosives.

GELATINA VENDER

Italian Gelatin Dynamite. See Dinamite under Italian Explosives.

GELATIN DYNAMITE & GELATIN DYNAMITE-TYPE EXPLOSIVES (blasting explosive)

a) Foreign Nomenclature:

Britain:	Gelignite & Gelatine Dynamite
Belgium:	Forcite & Forcite Extra
France:	Dynamite gélatine, Gélatine, Gélignite, Gomme & Nobélite
Germany:	Ammongelatine, Fördit, Gelatine dynamit, & Nobelit.
Hungary:	Dinamit, Dinamitgél, Gelignit & Nitrozselatinos
Italy:	Ammon dinàmite (Gelatina), Amon gelàtina, Esplosivo da mina gelatinoso, Gelatina 40%, Gelatina dinamite, Gelatina esplosiva, Gelatina Vender, Gelignite, Gomma A & B, Gomma incongelabile & Nitrogelatina
Japan	Bakuhatsu-Sei Zeratin, Keyaki; Kiri Nos 1,2 & 3; Shin-Kiri, Shinkyoryoku, Shiraume; Take Nos 1,2 & 3; and Toku-Shiraume Nos 1,2 & 3;
Soviet Union:	Studenistyi dinamit & Zhelatin dynamit
Spain:	Gelatina dinamita & Nitrogelatina
Sweden:	Ammongelatin Dynamit, Gelatinerad Dynamit & Nobelit
Switzerland:	Gamsit or Gelatine-Gamsit, Gelatine-Aldorfit, Gelatine Cheddit, Gelatine-Dynamit, Gelatin-Pentrinit, Gelatine-Telsit, Nitrogelatinedynamit & Telsit.

b) Origin:

Gelatin Dynamite was invented by A. Nobel in 1875. His invention of Blasting Gelatin is covered by the same patent. Nobel found that by incorporating an oxidizing agent & a combustible material into gelatinized Nitroglycerin, a cheaper & less powerful explosive could be formulated. Thus, Gelatin Dynamites can be considered as Blasting Gelatin to which woodmeal & sodium or potassium nitrates have been added. They may also contain Ammonium Nitrate ("Ammonia Gelatin Dynamite") & aromatic nitrocompounds as additives. However, Gelatin Dynamites have a lower Nitrocellulose content than Blasting Gelatin and are therefore softer gelatins.

c) Composition & Characteristics:

Some examples of typical US Gelatin Dynamite compositions are as follows:

	Strength of Dynamite, %		
Composition	20	40	60
Nitroglycerin	20.2	32.0	49.6
Nitrocellulose	0.4	0.7	1.2
Sodium nitrate	60.3	51.8	38.9
Combustible material	16.7	13.4	8.3
Antiacid	1.5	1.2	1.1
Moisture	0.9	0.9	0.9
Rate of Detonation, meters/second	4000	5200	6200
Ballistic Pendulum test, % TNT	74	85	99

The composition & some characteristics of foreign Gelatin Dynamites are given under the individual entries & countries indicated above by Foreign Nomenclature.

In general, Gelatin Dynamites are plastic & cohesive explosives. They may be shaped & molded as desired. Their hygroscopicity depends upon the types and quantities of oxidizer & combustible ingredients. Gelatin Dynamites are about as sensitive to shock as Blasting Gelatin. The moist Gelatin Dynamite is less sensitive than the dry material. Sensitivity to initiation varies

c) Composition & Characteristics (cont'd):

with the Nitrocellulose content, those with high Nitrocellulose content require a stronger blasting cap. Long periods of storage may cause Gelatin Dynamites to decrease in their sensitivity to initiation.

d) Uses:

Gelatin Dynamites are used for blasting rock & for underwater blasting operations. Ammonium Nitrate Gelatins, despite their higher strength, are not suitable for hard ore or rock blasting because of their lower velocity of detonation.

GÉLATINE

French Gelatin Dynamite.

GELATINE-ALDORFIT

Swiss Gelatin Dynamite.

GELATINE-CHEDDIT

Swiss Gelatin Cheddite.

GELATINE DYNAMIT

German Gelatin Dynamite.

GELATINE-DYNAMIT

Swiss Gelatin Dynamite.

GELATINE-GAMSIT

See Gamsit under Swiss Explosives.

GELATINE-PENTRINIT

Swiss Plastic Explosives.

GELATINERAD DYNAMIT

Swedish Gelatin Dynamite.

GELBMEHL

German for Tetranitrocarbazole.

GELIGNITE

Italian Gelatin Dynamite.

GÉLIGNITE

French Gelatin Dynamite.

GESTEINSSPRENGSTOFFE

German Rockblasting Explosives.

GHEKSOGHEN

Russian for RDX.

GOMA

Spanish Blasting Gelatin. See Dinamita under Spanish Explosives.

GOMMA A & B

Italian Gelatin Dynamite. See Esplosivo da mina gelatinoso con nitroglicerina under Italian Explosives.

GOMMA INCOGELABILE

Italian Gelatin Dynamite.

GOMME

French Dynamite.

GRANATFÜLLUNG 88

German for Picric Acid. See Fullpulver Nr 2 under German Explosives.

GREMUCHAYA RTUT' or FUL'MINAT RTUTI

Russian for Mercury Fulminate.

GREMUCHE-RTUTNAYA

See Kapsiuli detonatory under Soviet Explosives.

GREMUCHII STUDEN'

Soviet Blasting Gelatin.

GRISOUDYNAMITE

French Permissible Dynamite.

GRISOUNAPHTALITE

French Permissible Dynamite.

GRISOUTÉTRYLITE

French Permissible Dynamite.

GRISUTIN

Soviet Dynamite.

GROMOBOY (bursting charge)

A Soviet high explosive bursting charge for Shells & Mines. There is no corresponding US composition. See under Soviet Explosives.

G-SALZ

German name for Nitroguanidine.

GUHRDYNAMIT

German Dynamite.

GUNCOTTON

a) Foreign Nomenclature:

Belgium:	Coton-poudre
Bulgaria:	Trioksilin
France:	Coton-collodion, coton-nitre, coton-poudre, fulmicoton
Germany:	Kollodiumwolle, nitrozellulosepulver, schiessbaumwolle, schieswolle
Italy:	Fulmicotone, cotone fulminante
Japan:	Menyaku
Soviet Union:	Piroksilin, khlopchatobumazhnyy porokh
Spain:	Algodón pólvora, fulmicotón
Sweden:	Bomukhskrut

b) Composition:

Uncolloided Nitrocellulose	87%
Moisture	13%

c) Characteristics:

Guncotton is a white explosive material. It will ignite when subjected to a temperature of from 195° to 200°C for 5 seconds. It is nonreactive with metals. It is about 98% as strong as TNT. When dry, it is 19% stronger than TNT. Like other single-base propellants, it is hygroscopic and unstable. 30% moisture will prevent ignition. It is about as sensitive as TNT. Dry, it is about as sensitive as PETN.

d) Uses:

Guncotton is commonly used as a propellant, occasionally as a demolition agent.

e) Comments:

The term "guncotton" is commonly applied to forms of nitrocellulose containing 13% or more nitrogen.

H_2 KONGO or TYPE 98 (Explosive) (main bursting charge)

A Japanese castable main explosive filler used in place of Picric Acid. There is no corresponding US composition. See under Japanese Explosives.

HAENSOSAN BAKUYAKU or TYPE 88 (Ko) (main bursting charge)

A Japanese explosive filler for Sea Mines. There is no corresponding US composition. See under Japanese Explosives.

HAISHOKUYAKU (demolition & mining explosive)

A Japanese military demolition & commercial mining explosive. There is no corresponding US composition. See under Japanese Explosives.

HELLHOFFIT

A German Sprengel-type explosive.

HEXA, HEXAMIN, HEXANITRODIPHENYLAMIN or HEXYL

German names for Hexanitrodiphenylamine.

HEXAL (bursting charge)

A German press-loaded mixture of aluminized RDX. There is no corresponding US composition. See under German Explosives.

HEXALITA, HEXAMINA or HEXIL

Spanish names for Hexanitrodiphenylamine. See Hexalita under Spanish Explosives.

HEXAMIN

One of several German names for Hexanitrodiphenylamine.

HEXAMINA

One of several Spanish names for Hexanitrodiphenylamine. See Hexalita under Spanish Explosives.

HEXAMINE, HEXANITRODIPHÉNYLAMINE or HEXYL

French for Hexanitrodiphenylamine.

HEXAMIT or HEXANIT (bursting charge)

A German castable underwater bursting charge. Similar mixtures were used by the Japanese under the names Seigata (Army) & Type 97H (Navy), and by Sweden under the name Novit. See Hexamit under German Explosives.

HEXANITRODIFENYLAMIN

Swedish for Hexanitrodiphenylamine.

HEXANITRODIPHENYLAMIN

One of several German names for Hexanitrodiphenylamine.

HEXANITRODIPHÉNYLAMINE

French for Hexanitrodiphenylamine. See Hexamine under French Explosives.

HEXANITRODIPHENYLAMINE (high explosive)

a) Foreign Nomenclature:

France:	Hexamine, Hexanitrodiphénylamine & Hexyl
Germany:	Hexa, Hexamin, Hexanitrodiphenylamin & Hexyl
Italy:	p-Dipicrilammina, Esanitrodifenil-ammina & Exil
Spain:	Hexalita, Hexamina, Hexanitro-difenilamina, Hexil & Hexita
Sweden:	Hexanitrodifenylamin
Switzerland:	Hexanitrodiphenylamin & Hexyl

b) Origin:

It was first prepared in 1874, independently, by P.T. Austen who reported its formation by the nitration of picryl-p-nitroaniline, and by R. Gnehm by the nitration of methyldiphenylamine. K. H. Mertens prepared this compound in 1878 by the nitration of diphenylamine. The large-scale preparation of Hexanitrodiphenylamine by direct nitration of diphenylamine was reported in 1910, although a patent for its manufacture from Dinitrochlorbenzene & aniline was granted in Germany in 1891. The chemical & explosive properties of the compound had been studied by several investigators prior to its large-scale production.

c) Characteristics:

Hexanitrodiphenylamine, $(O_2N)_3C_6H_2NHC_6H_2(NO_2)_3$, molecular weight 439.22, Nitrogen content 22.33%, is a high-explosive compound which forms yellow prisms from acetic acid or 93% nitric acid. It melts with decomposition at 243-245°C. It is nearly insoluble in water or chloroform, slightly soluble in ether or cold acetic acid, moderately soluble in alcohol, and readily soluble in acetone, warm acetic acid or alkalies, except potassium hydroxide.

Reports on toxicity of the compound are conflicting, but it seems to cause dermatitis. Like diphenylamine, it attacks the skin, producing blisters similar to those produced by burns. Its dust is very injurious to the mucous membranes of the mouth, nose & lungs.

Hexanitrodiphenylamine as an explosive is slightly more powerful & brisant than TNT, and its sensitivity to impact is about the same as that of Tetryl. At a density of 1.58 gm/cc, its rate of detonation is 6995 meters/second, and 7145 meters/second at density 1.67 gm/cc. The compound is stable in storage at elevated temperatures.

d) Uses:

Due to its high melting point, Hexanitrodiphenylamine is usually blended with other high explosives in order to make a castable bursting charge. It has been suggested that a mixture with 1% stearic acid would permit the pressing of pellets which could be used as a booster instead of Tetryl. The use of Hexanitrodiphenylamine in admixtures with Potassium Chlorate, antimony trisulfide & Lead Thiocyanate has been patented as a priming charge for small arms ammunition.

HEXANITROSORBITOL

See Esanitrosorbite under Italian Explosives.

HEXA SPRENGSTOFFE (bursting charges)

A name applied to a group of German Substitute Explosives based on Ammonium Nitrate. There are no corresponding US compositions. See under German Explosives.

HEXIL

One of several Spanish names for Hexanitrodiphenylamine. See Hexalita under Spanish Explosives.

HEXOGEN

Name used in Germany, Sweden & Switzerland for RDX.

HEXOGÈNE

French for RDX.

HEXOGÈNE/CIRE d'ABEILLE

French for Composition A.

HEXOLIT

German High Explosive or Propellant.

HEXOLITE or HT

French for Composition B. Also Belgian.

HEXONIT

Swiss Plastic Explosive.

HEXONITA (bursting charge)

A Spanish explosive consisting of RDX & Nitroglycerin which may be gelatinized by the addition of Collodion Cotton. There is no corresponding US composition. See under Spanish Explosives.

HEXOPLAST 75

German plastic explosive.

HEXOTOL

Swedish name for 60/40 Cyclotol.

HEXOTONAL

Swedish name for Torpex.

HEXYL

French & German name for Hexanitrodiphenylamine. See Hexamine under French Explosives and Hexa under German Explosives.

HMX or CYCLOTETRAMETHYLENETETRANITRAMINE (high explosive)

a) Foreign Nomenclature:

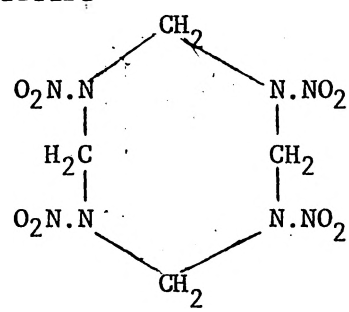
Britain:	HMX (High Melting Explosive or His Majesty's Explosive)
France:	Cyclotetraméthylènetetranitramine or Octogène
Germany:	Octogen
Soviet Union:	Oktoghen

b) Origin:

HMX is formed, under some conditions, in the nitration of hexamethyleneteramine. It is present in Type B RDX. HMX exists in at least 4 polymorphic forms. Ordinarily the least sensitive beta form is produced.

c) Characteristics:

HMX is a high-explosive compound having the structure



It is similar in structure to RDX and is its next higher homolog. HMX has a molecular weight of 296.17 & Nitrogen content 37.8%. It forms white crystals that melt at 276-280°C and have a density of 1.87 gm/cc. It is practically insoluble in water and is nonhygroscopic, but soluble in other solvents which dissolve RDX. HMX is of the same order of sensitivity to impact & friction as RDX. It is less sensitive to initiation and has a higher explosion temperature (327°C) than RDX (260°C). HMX is about as powerful as RDX, but is indicated by tests to be even more stable than RDX.

d) Uses:

HMX is used alone & phlegmatized as a booster explosive, and in admixtures with other explosives to form composite bursting charges or special charges in some ammunition components. HMX is used in the US in some PBX (Plastic Bonded Explosive)-Type Explosives.

HOLTEX

Swiss (& German) High Explosive.

HT or HEXOLITE

French for Composition B. See Hexolite under French Explosives.

IDROLITA (bursting charge)

An Italian high explosive composition. There is no corresponding US mixture. See under Italian Explosives.

IGDANIT (blasting explosive)

A Soviet Ammonium Nitrate/fuel oil explosive. Similar mixtures are used in the USA for blasting purposes. See under Soviet Explosives.

IMPERIALITE (blasting explosive)

An Italian Ammonium Nitrate blasting explosive. There is no corresponding US composition. See under Italian Explosives.

INCENDIARIE (Miscele) (incendiary mixtures)

Some post-WW II Italian incendiary mixtures. There are no corresponding US compositions. See under Italian Explosives.

INCENDIARY BOMBS & COMPOSITIONS

See Brandbomben & Brandstoffe under German & Swiss Explosives.

INCENDIARY COMPOSITIONS

a) Foreign Nomenclature:

France:	Compositions Incendiaries
Germany:	Brandbomben, Brandsätze & Brandstoffe
Italy:	Incendiarie (Miscele)
Japan:	B4 (Incendiary) or Type 2 (Explosive)
Soviet Union:	Zazhigatel'nyiye Sostavy
Switzerland:	Brandbomben & Brandstoffe

b) Characteristics:

Incendiary Compositions are pyrotechnic mixtures of fuel, oxidizing agent & binder. Examples of two US compositions used in Projectiles are as follows:

50/50 Magnesium-aluminum alloy	48.0	48.0
Barium nitrate	50.5	50.5
Linseed oil	1.5	-
Asphaltum	-	1.5

Most Incendiary Compositions, as those above, are not stoichiometrically oxygen balanced, since the oxygen of the air plays a part in the burning of the mixture. This marked deficiency of oxygen, with respect to that required to cause complete oxidation of elements to their oxides, permits the use of an excess of fuel and consequently a more effective Incendiary. Essentially, the only gas produced in the above compositions is nitrogen. The chief products are the oxides of magnesium, aluminum & barium. These oxides become incandescent and have high incendiary value.

Incendiary Compositions should be sensitive to initiation by heat & impact, and should undergo steady burning rather than explosion.

c) Uses:

Most Incendiary Compositions are used in Small Arms Bullets, Artillery Projectiles & Bombs. Thermite-type mixtures are not sufficiently sensitive to be used in Projectiles. Thermites are used in Incendiary Bombs which are provided with an instantaneous Fuze & Burster (of Tetryl) to cause the Bomb to rupture above ground & scatter the filler.

INICIADORES EXPLOSIVOS

Spanish Initiating Explosives. See Explosivos primarios y iniciadores under Spanish Explosives.

INITIALEXPLOSIVSTOFFE & ZÜNDSPRENGSTOFFE.

Swiss Initiating and Priming Explosives.

INITIALSPRENGSTOFFE & ZÜNDHÜTCHENSÄTZE

German Priming & Initiating Compositions.

INITIATING & PRIMING COMPOSITIONS:

a) Foreign Nomenclature:

France:	Explosifs d'amorçage
Germany:	Initialsprengstoffe & Zündhütchensätze
Italy:	Esplosivo innescanti o primari
Japan:	Kibakuzai
Soviet Union:	Initsiiruyushchiye sostavy
Spain:	Explosivos iniciadores y primarios
Switzerland:	Initialexplosivstoffe & Zündsprengstoffe

b) Characteristics:

Initiating Agents used in military ammunition include Inital Detonating Agents & Priming Compositions.

Initial Detonating Agents are high explosives that are so sensitive to heat, impact & friction that they undergo detonation when subjected to a flame or physical influences. Most such explosives have distinctly lower rates of detonation & lower brisance values than the explosives they are used to initiate. Many compounds that have satisfactory initiating characteristics are either too unstable or too sensitive for use in military ammunition. Consequently, those actually in use are limited in number. The types of some compounds used include Azides, Fulminates, Diazocompounds, Nitro-compounds & Nitrosocompounds.

Priming Compositions are physical mixtures of materials that are very sensitive to impact or percussion and, when so exploded, undergo very rapid autocombustion. The products of such an explosion are hot gases & incandescent solid particles. Most military Priming Compositions consist

b) Characteristics (cont'd):

of mixtures of one or more Initial Detonating Agents, oxidizers, fuels, sensitizers & binding agents.

The sensitivity of Priming Compositions varies widely, and careful control of the granulation of each ingredient is important. Nonuniformity of the composition due to segregation of the ingredients can cause great variations in sensitivity, and even failure to function. The rate of burning of a Priming Composition, the volume of gases, and the weight of solid particles produced also determine the effectiveness of the composition as an Initiating Agent. Military Priming Compositions are of good stability, except those containing Mercury Fulminate. Compositions containing Mercury Fulminate undergo deterioration & desensitization if stored at slightly elevated temperatures. Compositions containing only nonexplosive ingredients, or those containing Lead Azide, Lead Styphnate, TNT or PETN are of a high order of stability.

c) Manufacturing Processes:

Because individual charges of Priming compositions are very small (0.05-0.2 gram) and because of their extreme sensitivity to friction, they are usually manufactured in small lots of 5 pounds or less. The ingredients are carefully weighed and placed on a triangular sheet of rubber, if a dry mixture is being prepared. A cord is attached to each corner of the sheet, which is placed behind a barricade, so that by raising the corners alternately, the ingredients can be mixed thoroughly. A final lifting operation discharges the mixture thru a screen into a rubber container.

If the composition is to be prepared wet with a binding agent, the ingredients are mixed in a doughmixer placed behind a barricade. The pasty product, so obtained, is loaded directly into Primers. Any volatile solvent remaining after the loading operations is removed by evaporation from the loaded Primers.

d) Uses:

Initial Detonating Agents are used to initiate detonation of the less sensitive high explosives which are employed as bursting charges, demolition charges & Dynamites.

Priming Compositions are used for the ignition of Initial Detonating Agents, Black Powder igniter charges & small arms Propellants.

INITSIIRUYUSHCHIYE SOSTAVY

Soviet Initiating Compositions. See Udarnyiye i Initsiiruyushchiye under Soviet Explosives.

ITALIAN UNKNOWN NAME EXPLOSIVES

Several military explosive compositions of undesignated names are described under Unknown Name Explosives in Italian Explosives.

JAPANESE "TYPE" EXPLOSIVES

A series of military explosives used by the Japanese Navy. See Type Explosives under Japanese Explosives.

JAPANESE UNKNOWN NAME EXPLOSIVES

A list of explosives designated X-1 to X-8, for convenience, is described under Unknown Name Explosives in Japanese Explosives.

K-1 SPLAV (bursting charge)

A Soviet castable high-explosive filler for Land Mines. There is no corresponding US composition. See under Soviet Explosives.

K-2 SPLAV (bursting charge)

A Soviet castable high explosive filler for Land Mines & small caliber Shells. There is no corresponding US composition. See under Soviet Explosives.

<u>KAÏPINITE</u> (demolition & mining explosive)

A French Cheddite-type demolition & mining explosive. French composition is based on Belgian Yonckite. See under French Explosives.

<u>KALIIALMATRIT No. 55</u> (blasting explosive)

A Soviet commercial blasting explosive. There is no corresponding US composition. See Almatrit under Soviet Explosives.

<u>KAPSIULI DETONATORY</u>

Soviet Detonator Caps.

<u>KARITTO</u> (Army) or <u>TYPE 88</u> (Navy) (bursting charge & blasting explosive)

A Japanese granular explosive mixture used in Sea Mines & as a substitute Demolition charge. There is no corresponding US composition. See under Japanese Explosives.

<u>KA-SALZ</u>

One of several German names for RDX. See Hexogen under German Explosives.

<u>KASSHOKUYAKU</u>

Japanese Brown Powder.

<u>KEINEYAKU</u> (main bursting charge)

Japanese for Trinitrophenetole. Used cast loaded as a main charge in Projectiles. See under Japanese Explosives.

<u>KEYAKI</u>

Japanese Ammonium Nitrate Gelatin.

KH-LADUNG

German designation for a compressed TNT charge.

KHLOPCHATOBUMAZHNYI POROKH

Soviet Guncotton.

KIBAKUYAKI

Japanese for Initiating Explosive. See Bakufun & Raibun under Japanese Explosives.

KIBAKUZAI

Japanese for Primer Charge. See Chikkaen (Navy) or Chikka Namari (Army) & Raikō or Raisan Suigin under Japanese Explosives.

KIRI Nos 1, 2 & 3

Japanese Ammonium Nitrate Gelatin.

KMA LADUNG (bursting charge)

A German castable substitute explosive. There is no corresponding US composition. See under German Explosives.

KNALLKVICKSILVER

Swedish for Mercury Fulminate.

KNALLQUECKSILBER

German for Mercury Fulminate.

KNALLZÜNDSCHNUR

Name used in Switzerland for Detonating Fuse or Primacord.

Ko (Explosive), HAENSOSAN BAKUYAKU or TYPE 88 (Ko)

See under Japanese Explosives.

KOHLENSPRENGSTOFFE

German coal mining explosives.

KOKOSHOKUYAKU or YUENYAKU

Japanese Black Powder.

KOLLODIUMWOLLE

Name used in Switzerland for Collodion Cotton grade Nitrocellulose.

KOLLOKSILIN

Soviet Collodion Cotton.

KOMBINIROVANNAYA AZIDO-TETRILOVAYA

See Kapsiuli detonatory under Soviet Explosives.

KOMBINIROVANNAYA GREMUCHERTUTNO-TETRILOVAYA

See Kapsiuli detonatory under Soviet Explosives.

KOSHITSU, OSHITSUYAKU or SHOUYAKU KOSHITSU (main demolition ch

A Japanese, plastic explosive mixture similar to US experimental RIPE. See under Japanese Explosives.

KO-SHOAN BAKUYAKU

Japanese Ammonium Nitrate Dynamite.

K-SALZ

One of several German names for RDX. See Hexogen und German Explosives.

KSILIL or XYLYL

Russian for Trinitroxylene.

LEAD AZIDE (priming & initiating explosive)

a) Foreign Nomenclature:

Belgium:	Azoture de plomb or Nitrure de plomb
France:	Azide de plomb or Nitrure de plomb
Germany:	Bleiazid
Italy:	Acido di piombo, Azotidrato di piombo or Azotidruro di piombo
Japan:	Chikkaen (Navy) & Chikka Namari (Army)
Soviet Union:	Azid svintsa
Spain:	Azida de plomo, Nitruro de plomo & Plumbazida
Sweden:	Blyazid (Blyacid)
Switzerland:	Bleiazid

b) Origin:

Lead Azide was first prepared in 1891 by T. Curtius by adding lead acetate to a solution of sodium or Ammonium Azide. T. Curtius & J. Rissom (1898) also prepared Lead Azide by the action of Hydrazoic Acid (aqueous Hydrogen Azide) on a lead salt. Many investigators later prepared Lead Azides and studied its explosive properties. The hazards involved in the manufacture of pure crystalline Lead Azide delayed its practical use for many years. Many foreign countries have manufactured & used pure Lead Azide since 1920. Its military & commercial uses in the USA, since 1931, have been restricted to crystalline Lead Azide which is desensitized with dextrin. A colloidal form of Lead Azide which is not dextrinated has been manufactured in the USA on a small scale since 1957.

c) Chemical Composition and Physical Properties:

Lead Azide, $N{\equiv}N{=}N{-}Pb{-}N{=}N{\equiv}N$, molecular weight 291.96, Nitrogen content 28.86%, is a compound of colorless crystals. Does not melt but decomposes at 240-250°C when pure. It exists in two modifications: orthorhomic (alpha form) of density 4.71 gm/cc; and monoclinic (beta form) of density 4.93 gm/cc.

c) Chemical Composition and Physical Properties (cont'd):

The monoclinic form of Lead Azide is the much more sensitive form. Lead Azide is very soluble in acetic acid, very slightly soluble in water, and almost insoluble in ether, acetone, alcohol, ammonia & common organic solvents. Lead Azide can be dissolved in monoethanolamine or in a 50/50 mixture of monoethanolamine/ammonia, from which it may be precipitated by adding dilute acetic acid. The resulting product, however, is reported to be impure.

d) Test Methods and Explosive Characteristics:

Lead Azide is exploded, by heating at 315°C to 360°C, in 5 seconds. It is less brisant & less powerful than Mercury Fulminate. The rate of detonation is 4500 meters/second at a pressed density of 3.8 gm/cc, 5300 meters/second at density 4.6 gm/cc, and 5400 meters/second at its maximum pressed density. Lead Azide is more sensitive to initiation by friction than Mercury Fulminate, but less sensitive to impact than Mercury Fulminate, Lead Styphnate, Diazodinitrophenol & Tetracene. Lead Azide is an excellent initiating agent for high explosives, and markedly superior as an initiator for the more sensitive explosives such as Tetryl, RDX & PETN.

e) Manufacturing Processes:

In the manufacture of Lead Azide, the size & shape of the crystals are most important. Lead Azide for military use by most countries is required to be white to buff in color, spherical in shape & free from needle-shaped crystals.

Because of its sensitivity, Lead Azide is usually manufactured in small quantities both in the laboratory and in the plant-scale processes. Formation of the extremely sensitive orthorhombic form is prevented by the very slow mixing of very dilute solutions of lead nitrate & sodium azide from which Lead Azide is prepared. It is also produced in the form of finely divided amorphous aggregates by the rapid mixing of relatively concentrated solutions of lead nitrate & sodium azide. Dextrin is sometimes added to prevent the formation of large, sensitive crystals of Lead Azide.

e) Manufacturing Processes (cont'd):

Argentina, Germany, some other European countries & the USA have adopted dextrinated Lead Azide as their military type, while Great Britain prefers crystalline Lead Azide built around a nucleus of lead carbonate. This British "service" Lead Azide is superior in functioning characteristics to dextrinated Lead Azide. The British also manufacture an experimental Lead Azide, considered to be an improvement of the service type.

f) Safety Hazards:

Lead Azide is not considered to be particularly toxic; but inhalation of the dust should be avoided, as this causes a headache & distention of the blood vessels. It is recommended that the Lead Azide content of air be prevented from exceeding 0.2 milligram per cubic meter of air in order to avoid undue toxicity.

In the presence of moisture, Lead Azide corrodes copper to form the extremely sensitive & dangerous Cupric Azide. For this reason, Lead Azide is not loaded so as to be in direct contact with uncoated copper or its alloys.

When wet with water or alcohol, Lead Azide is still sensitive to detonation by impact. It is reported that Lead Azide can be made safe for handling by wetting it with a nonflammable liquid such as dichloroethyl ether. This liquid is a non-solvent for Lead Azide; it is less volatile than either alcohol or water, and is capable of complete removal by drying.

g) Storage:

The thermal stability of both dextrinated & pure Lead Azide is exceptional. Lead Azide has been found unchanged with respect to purity & brisance after storage for 25 months at 50°C, and after prolonged storage under an alcohol-water mixture at room temperature. Storage at 80°C for 15 months caused no decrease in the brisance of Lead Azide. Similar storage of a Priming Composition containing Lead Azide showed no decrease in its sensitivity to stab action.

g) Storage (cont'd):

Because of the sensitivity to shock & friction of Lead Azide and other Initiating Explosives, they are required to be packed & stored in a wet condition. Water can be used for this purpose, but, under low temperature conditions, a mixture of equal weights of water & ethyl alcohol is recommended. About 25 pounds of Lead Azide, wet with not less than 20% of liquid, is stored in a duck or rubberized cloth bag securely tied. Not more than six such bags should be stored together in a larger bag of the same material. The larger bag is stored in the center of a water-tight metal or wooden drum containing sawdust, saturated with water, as a surround for the bag. The maximum weight of Lead Azide (dry weight), stored in a single container, should be not more than 150 pounds.

For purposes of quantity-distance storage and compatibility grouping for mixed storage, Lead Azide is a Class 9, Group M (wet) explosive.

h) Demilitarization and/or Disposal Procedures:

Lead Azide cannot be destroyed by burning, Hence relatively large quantities are destroyed by detonating them; small quantities are decomposed by chemical means.

The destruction by detonation should be carried out in a pit not less than 4 feet deep, and the explosive should be covered with at least 2 feet of earth. If space permits, the explosive can be detonated in the open. The maximum quantity to be detonated at one time is determined by the nearest structure which might be affected by blast or missiles resulting from the explosion. Detonation of Lead Azide is accomplished by the use of Demolition Blocks which can be initiated by electric Blasting Caps.

Lead Azide can be destroyed chemically by any one of the following methods:

1) Mix with at least 5 times its weight of a 10% sodium hydroxide solution and allow the mixture to stand for 16 hours with occasional stirring. The resulting supernatant solution of sodium azide (nonexplosive) is decanted and disposed of by drainage into the ground.

h) Demilitarization and/or Disposal Procedures (Cont'd):

2) Dissolve in a 10% ammonium acetate solution and add a 10% sodium or potassium bichromate solution until no more yellow lead chromate is precipitated.

3) Wet with 500 times its weight of water, slowly add 12 times its weight of a 25% sodium nitrite solution, agitate, and then slowly add 14 times its weight of a 36% nitric acid or glacial acetic acid solution. A red color produced on adding ferric chloride solution indicates that Lead Azide is still present. Toxic fumes of nitrogen oxides are liberated in this process.

4) Dissolve in 50 times its weight of a 15% ceric ammonium nitrate solution. Lead Azide is decomposed with the evolution of nitrogen gas.

i) Uses:

Lead Azide is used in Detonators & Primers to replace either wholly or in part Mercury Fulminate. Lead Azide is also used as an Initiating Agent in military ammunition, and as an ingredient of Priming Compositions which are physical mixtures of materials that are very sensitive to impact or percussion, and when exploded undergo very rapid autocombustion.

LEAD PICRATE

See Bleipikrat under German Explosives.

LEAD STYPHNATE or **LEAD TRINITRORESORCINATE** (initiating explosive)

a) Foreign Nomenclature:

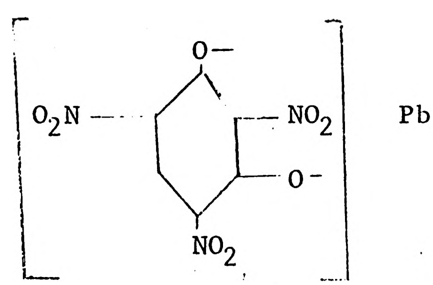
Belgium:	Trinitrorésorcinate de plomb
France:	Styphnate de plomb & Trinitro-résorcinate de plomb
Germany:	Bleistyphnat & Bleitrinitro-resorcinat
Italy:	Stifnato di piombo & Trinitro-resorcinato di piombo
Soviet Union:	Stifnat svintsa & Trinitro-resorsinat svintsa (TNRS)
Spain:	Tricinato (Triginato) & Trinitro-resorcinato de plomo
Sweden:	Blystyfnat & Blytrinitroresorcinat
Switzerland:	Bleistyphnat & Bleitrinitro-resorcinat

b) Origin:

Lead Styphnate was first described in Germany in 1914 by E. von Herz, and found by R. Wallbaum to be a relatively poor initiator in comparison with other primary explosives. I.E. Moisak of the USSR showed that Lead Styphnate could be used as a cover charge for Lead Azide and provided protection from mechanical & chemical influences. At the same time Lead Styphnate increased the impulse & detonating ability of the total charge.

c) Chemical Composition and Physical Properties:

Lead Styphnate is an explosive compound having the structure:



It has a molecular weight of 450.30 and a Nitrogen content of 9.33%. It forms light orange or reddish brown crystals containing one mole of water of crystallization. The crystal density of the monohydrate is 3.02 gm/cc and of the anhydrous salt 2.90 gm/cc. The compound melts with explosive

c) Chemical Composition and Physical Properties (cont'd):

violence at 260-310°C. It is practically insoluble in water, acetone, ethanol, ether, chloroform, carbon tetrachloride, carbon bisulfide, benzene, toluene, hydrochloric acid & glacial acetic acid. It is somewhat soluble in a 10% aqueous solution of ammonium acetate.

d) Characteristics:

Lead Styphnate is slightly less sensitive to impact than either Mercury Fulminate or Diazodinitrophenol, but is more sensitive than Lead Azide. It is less sensitive to friction than Mercury Fulminate & Lead Azide, but is more easily ignited by an electrical spark than is Mercury Fulminate, Lead Azide or Diazodinitrophenol. Lead Styphnate pressed to a density of 2.9 gm/cc has a rate of detonation of 5200 meters/second. Other tests indicate it to be equally as powerful as Mercury Fulminate and more powerful than Lead Azide.

In spite of its favorable rate of detonation & power characteristics, Lead Styphnate is a relatively poor initiator of detonation. It is incapable of initiating the detonation of any military high explosive except PETN.

Lead Styphnate is of a high order of stability. Storage at 80°C does not impair its stability, which is considered to approach that of Lead Azide and to be better than Mercury Fulminate & Diazodinitrophenol.

e) Manufacturing Processes:

Lead Styphnate is prepared by the reaction of lead nitrate or lead acetate with either sodium or magnesium styphnate in the presence of an acid. In commercial production, the magnesium salt is used. The insoluble product is filtered off and washed with water until free of acid. Like other initial detonating compounds, Lead Styphnate is kept wet until ready for use.

f) Demilitarization and/or Disposal Procedures:

Lead Styphnate is decomposed by dissolving it in at least 40 times its weight of 20% sodium hydroxide solution, or 100 times its weight of a 20% solution of ammonium acetate. Then add a solution of sodium dichromate, equal to half the weight of styphnate, prepared in 10 times its weight of water. Allow the solutions to mix & settle. Discard the mixture by draining it into a disposal pit and cover with earth.

g) Uses:

The ease of ignition of Lead Styphnate renders its suitable for use as an igniting charge for Lead Azide, and as an ingredient of Priming Compositions.

LEONIT

A German permissible Cheddite.

LEUCHTSÄTZE & LEUCHTBOMBEN

German Illuminating Compositions & Bombs. See Feuerwerkerei under German Explosives.

LEUCHTKUGELN or FACKELN

German Flares. See Feuerwerkerei under German Explosives.

L-SHOAN

Japanese Ammonium Nitrate Dynamite.

L-SPLAV (bursting charge)

A Soviet castable explosive mixture used as a bursting charge for Antitank Mines and in Demolition Blocks. There is no corresponding US composition. See under Soviet Explosives.

MABT (bursting charge)

An Italian castable explosive composition. There is no corresponding US composition. See under Italian Explosives.

MACARITA

Spanish name for an explosive known in the US & Britain as Plumbatol. See Macarite under Belgian Explosives.

MACARITE (main bursting charge)

Belgian designation for a castable high-explosive charge known in the US & Britain as Plumbatol. See under Belgian Explosives.

MANLIANITE (blasting explosive)

An Italian Cheddite-type blasting explosive. There is no corresponding US composition. See under Italian Explosives.

MANSIT (bursting charge)

A Soviet press-loaded explosive charge. There is no corresponding US composition. See under Soviet Explosives.

MAT (bursting charge)

An Italian & Spanish castable Picratol. See under Italian Explosives.

MATAGNITE (blasting explosive)

A current Belgian mining explosive developed and manufactured in Belgium. See under Belgian Explosives.

MATSU

Japanese Blasting Gelatin.

MBT (main bursting charge)

An Italian & Spanish castable explosive mixture. There is no corresponding US composition. See under Italian Explosives.

MDN or MDn (bursting charg)

A French & Spanish castable Picric Acid composition. There is no corresponding US composition. See under French Explosives.

MDPC (bursting charge)

A French & Spanish castable Picric Acid composition. There is no corresponding US composition. See under French Explosives.

MEIAYAKU or SANSHŌKI MECHIRU NITOROAMIN

Japanese for Tetryl.

MÉLANGE MASSENET (incendiary pyrotechnic)

A French Incendiary Pyrotechnic mixture. There is no corresponding US composition. See under French Explosives.

MÉLANGE NPMn (booster charge)

A French PETN booster explosive mixture. There is no corresponding US composition. See Relais (Explosif pour) under French Explosives.

MELINIT

Russian for Picric Acid.

MELINITA, PERTITE, TRINITROFENOLO or ACIDO PICRICO

Italian for Picric Acid.

MÉLINITE, TRINITROPHÉNOL or ACIDE PICRIQUE

French for Picric Acid.

MENKAYAKU

Japanese for Nitrocellulose.

MENYAKU

Japanese for Guncotton.

MERCURY FULMINATE (priming & initiating explosive)

a) Foreign Nomenclature:

Belgium:	Fulminate de mercure
France:	Fulminate de mercure
Germany:	Knallquecksilber
Hungary:	Higanyfulminát, durranóhigany
Italy:	Fulminato di mercurio
Japan:	Raikō & Raisan Suigin
Soviet Union:	Ful'minat rtuti & Gremuchaya rtut'
Spain:	Fulminato de mercurio
Sweden:	Knallkvicksilver
Switzerland:	Knallquecksilber

b) Origin:

"Mercury Fulminate was first prepared by J.K. Lowenstern (1630-1703) but it was in 1800 that its preparation & properties were first described in detail by E. Howard in a paper presented to the Royal Society of London. It was 1867 before this compound was used as an Initiating Agent, when A. Nobel invented the Blasting Cap and used Mercury Fulminate to detonate Nitroglycerin.

c) Chemical Composition and Physical Properties:

Mercury Fulminate, CN-O-Hg-O-NC, molecular weight 284.65, Nitrogen content 9.80%, is a salt that is white when pure, but, as manufactured (98-99% pure), it is grayish in color. It forms octahedral crystals which are usually truncated. Mercury Fulminate has a crystal density of 4.42 gm/cc. Pressures above 25,000 psi cause the desensitization of Mercury Fulminate to such an extent that the "dead pressed" material merely ignites & burns. It is soluble in aqueous ammonium hydroxide, potassium cyanide & pyridine, and can be recovered from such solutions by treating the ammonium or potassium solution with acid, or by adding water to the pyridine solution.

d) Test Methods and Explosive Characteristics:

Mercury Fulminate is more sensitive to impact than Lead Azide or Lead Styphnate. It is of the same order of sensitivity as Diazodinitrophenol & Tetracene. These three compounds are the

d) Test Methods and Explosive Characteristics (cont'd):

most sensitive initiating explosives used in military ammunition. Mercury Fulminate is more sensitive to heat & friction than Lead Azide & Lead styphnate, and has a higher explosion temperature (210°C) than Diazodinitrophenol & Tetracene. It is distinctly more powerful than Lead Azide. The rate of detonation of Mercury Fulminate at a pressed density of 4.0 gm/cc is 5000 meters/second.

e) Manufacturing Processes:

Mercury Fulminate is manufactured in relatively small quantities. A solution of 1 pound of redistilled mercury in 8-10 pounds of nitric acid is heated at 55-60°C and poured into a large flask containing 8-10 pounds of ethanol. After 1 1/2 hours the reaction is complete and the separated Fulminate is caught on a screen and washed with water until free of acid. The product is not more than 99% pure. It can be purified to 99.75% or higher by dissolving in ammonium hydroxide, filtering, and reprecipitating slowly, by adding concentrated nitric acid, with rapid agitation, at a temperature below 35°C.

f) Safety Hazards:

Mercury Fulminate & other mercury compounds are of recognized toxicity. Its dust should not be inhaled. It is recommended that, in order to avoid undue exposure, the air in loading buildings should contain not more than 0.1 milligram of Mercury Fulminate per cubic meter of air.

g) Inspection Procedures:

Mercury Fulminate reacts with concentrated sulfuric acid to form hydroxylamine ($H_2N.OH$) & formic acid (HCOOH). This reaction can be used to determine the purity of Mercury Fulminate. The pure compound does not react with ordinary metals. However, the standard grade may contain as much as 1% of free mercury which can cause slight corrosion of copper & its alloys.

h) Storage:

Mercury Fulminate is stored wet with water in cloth bags until ready for use. When there is danger of freezing, a mixture of equal volumes of water & ethanol or methanol is used.

The relatively poor stability of Mercury Fulminate is one of its most disadvantageous characteristic and the main reason why efforts are made to replace it with a superior initiator. Mercury Fulminate of 99.75% purity after only 8 months storage at 50°C is deteriorated to 95%, and in 11 months is deteriorated to 92% purity. When Mercury Fulminate deteriorates, it is chiefly with the production of a nonexplosive solid rather than gaseous products of decomposition. It has been found that with a reduction in purity to 92%, the initiating efficiency of Mercury Fulminate is practically destroyed, although it will explode when ignited.

i) Demilitarization and/or Disposal Procedures:

Mercury Fulminate is decomposed by adding it, while stirring, to 10 times its weight of a 20% sodium thiosulfate solution in a wooden or earthenware container. Avoid inhaling the fumes produced, as some poisonous cyanogen gas is produced by this procedure. Discard the mixture by draining it into a disposal pit, and cover with earth.

j) Uses:

Because of its sensitivity to flame & percussion, Mercury Fulminate was for many years the most important explosive used in Detonators & in Priming Compositions. It is still universally used for these purposes, but efforts have been made by many countries to replace Mercury Fulminate with Lead Azide. Mercury Fulminate may be found in some commercial Blasting Caps & military ammunition in use today.

METHYLAMINE NITRATE

See Man-Salz under German Explosives.

METRIOL TRINITRATE

See Metriolo under Italian Explosives.

METRIOLO, NITROMETRIOLO or NITROPENTAGLICERINA

Italian for Metriol Trinitrate. See Metriolo under Italian Explosives.

MIEDZIANKIT

A German Cheddite-type explosive. See Chloratit under German Explosives.

MINOLEX

A Spanish castable explosive similar to British & US DBX composition. See under Spanish Explosives.

MINOLITE ANTIGRISOUTEUSE (blasting explosive)

A Belgian permissible mining explosive. There is no corresponding US composition. See under Belgian Explosives.

MMN

Spanish abbreviation for same explosive having French designation MMn.

MMn (Explosif) (bursting charge)

A French castable Picric Acid burster charge composition. There is no corresponding US composition. See under French Explosives.

MNDT or SIPERITE

See Siperite under Italian Explosives.

MONACHIT

A German high explosive composition. See Füllpulver Nr 57 under German Explosives.

MST or NOUGAT

See Nougat under Italian Explosives.

MTTC (bursting charge)

A French & Spanish castable Picric Acid composition. There is no corresponding US composition. See under French Explosives.

MTX (Explosif) (bursting charge)

A French castable Picric Acid bursting charge. There is no corresponding US composition. See under French Explosives.

MUENKAYAKU

Japanese for Smokeless Powder.

MYROL

German name for explosives based on Methyl Nitrate.

N (Explosif)

French designation for Ammonium Nitrate Explosives. See CSE (Explosif) & Explosif nitraté under French Explosives.

NAKOL'NAYA SMES' (priming composition)

A Soviet needle-action priming composition. There is no corresponding US composition. See under Soviet Explosives.

NATRIIALMATRIT No. 19 (blasting explosive)

A Soviet commercial blasting explosive. There is no corresponding US composition. See Almatrit under Soviet Explosives.

NEORODIT

A German commercial explosive. See under German Explosives.

NIGOTANŌYAKU, Mk 2

Japanese for Composition B.

NIPOLIT

A German High Explosive or Propellant composition.

NITOROGURISERIN

Japanese for Nitroglycerin.

NITRAMITE or AVIGLIANA 3

Italian Ammonal-type explosive. See Nitramite under Italian Explosives.

NITRATE d'AMMONIAQUE

French for Ammonium Nitrate. Also Belgian.

NITRATE de GUANIDINE

French for Nitroguanidine.

NITRATE de TRINITROPHÉNYLNIRAMINOÉTHANOL

French for Pentryl.

NITRATE d'URÉE

French for Urea Nitrate.

NITRATO AMMONICO or NITRATO d'AMMONIO

Italian for Ammonium Nitrate.

NITRATO AMÓNICO

Spanish for Ammonium Nitrate.

NITROBARONIT

A German aluminized Ammonium Nitrate explosive.

NITROBONCELLITE (mining explosive)

A current Belgian mining explosive of the same composition as Nitrocooppalite V. See under Belgian Explosives.

NITROCELLULOSA

Swedish for Nitrocellulose.

NITROCELLULOSA or NITROCOTONE

Italian for Nitrocellulose.

NITROCELLULOSE

French & German for Nitrocellulose. This name is also used in Switzerland.

NITROCELULOSA or PIROXILINA

Spanish for Nitrocellulose.

NITROCHLORIN

See under German Explosives.

NITROCOOPPALITE V & VIII (mining explosives)

Current Belgian dynamites developed and manufactured in Belgium. See under Belgium Explosives.

NITROCOTONE or NITROCELLULOSA

Italian for Nitrocellulose.

NITRODIGLICOLE or NITROETEROLO

Italian for Diethyleneglycoldinitrate.

NITROFORM or TRINITROMETHAN

See under German Explosives.

NITROGELATINA

Italian & Spanish Gelatin Dynamite.

NITROGELATINEDYNAMIT

Swiss Gelatin Dynamite.

NITROGLICERINA or ACEITO EXPLOSIVO

Spanish for Nitroglycerin. See Nitroglicerina under Spanish Explosives.

NITROGLICERINA, OLIO ESPLOSIVO or TRINITROGLICERINA

Italian for Nitroglycerin. See Nitroglicerina under Italian Explosives.

NITROGLITSERIN

Russian for Nitroglycerin.

NITROGLYCERIN (explosive ingredient of Dynamites & Propellants)

a) Foreign Nomenclature:

Belgium:	Nitroglycérine
France:	Nitroglycérine
Germany:	Nitroglycerin, Nitroglyzerin & Sprengol
Hungary:	Nitroglicerin & Robbanó-olaj
Italy:	Nitroglicerina, Olio esplosivo & Trinitroglicerina
Japan:	Nitoroguriserin
Soviet Union:	Nitroglitserin
Spain:	Aceite explosivo & Nitroglicerina
Sweden:	Nitroglycerin
Switzerland:	Nitroglycerin & Nitroglyzerin

b) Origin:

Nitroglycerin was first prepared in 1846-47 by an Italian chemist, A. Sobrero. For several years after this discovery, Nitroglycerin attracted little interest as an explosive until A. Nobel in 1864 patented improvements in its manufacture & method of initiation. Nobel used Nitroglycerin in Dynamites in 1867 and in Propellants called Ballistite & Cordite in 1888-89.

c) Identifying Features:

Nitroglycerin is an oily, colorless liquid when pure. The commercial product is yellowish to pale brown.

d) Chemical Composition and Physical Properties:

Nitroglycerin has the structure

$$\begin{array}{l} CH_2.ONO_2 \\ | \\ CH.ONO_2 \\ | \\ CH_2.ONO_2 \end{array}$$

and a molecular weight of 227.09. It contains the following percentages by weight of the elements: Carbon 15.9%, hydrogen 2.2%, Nitrogen 18.5% & oxygen 63.4%. The pure compound freezes to form rhombic crystals, which represent a stable form melting at 13.2°C. Under some conditions, triclinic crystals melting at 2.2°C, which represent a labile form, are formed. The labile form gradually changes into the stable form within 2 weeks.

d) Chemical Composition and Physical Properties (cont'd):

Nitroglycerin decomposes at 145°C with the ebullition of gaseous products, so that it appears to boil. True boiling occurs at 125°C under 2 mm of pressure, and at 180°C under 50 mm of mercury. Its density is 1.596 at 20°C, refractive index 1.4732 at 20°C, and viscosity is 0.36 poise at 20°C. Nitroglycerin is practically insoluble in cold water, soluble in ethanol, and miscible in all proportions with many organic solvents & nitric esters. Nitroglycerin has some solvent action on aromatic nitrocompounds, and is a gelatinizing agent for Nitrocellulose.

e) Test Methods and Explosive Characteristics:

Nitroglycerin is more sensitive to impact than Mercury Fulminate. It is extremely sensitive to friction. An increase in temperature increases its sensitivity markedly. At low temperatures, solid Nitroglycerin is much less sensitive than the liquid at normal temperature, but many accidents have occurred when frozen Dynamite was jarred while being thawed. Unconfined Nitroglycerin in a very small quantity burns without explosion. Very slight confinement causes the same quantity of material exposed to a flame to detonate with a loud report.

On the basis of sand test results, Nitroglycerin is shown to be as brisant as RDX and is surpassed in this respect only by PETN. Nitroglycerin, when properly initiated, undergoes its normal rate of detonation of 7700 meters/second. Tests, which measure explosive power, indicate Nitroglycerin to be more powerful than most standard military explosives.

f) Manufacturing Processes:

Nitroglycerin is manufactured by the nitration of glycerin with mixed acid containing 40% nitric acid, 59.5% sulfuric acid & 0.5% water. One part of glycerin is added to 4.3 parts of mixed acid at a temperature below 25°C. Agitation of the reaction mixture is accomplished by the use of compressed air. A rapid rise in temperature, or the appearance of red fumes, automatically requires dumping of the charge

f) Manufacturing Processes (cont'd):

immediately into a drowning vessel filled with water. When nitration is complete, the charge is run into a separator where the Nitroglycerin rises to the top. This is separated and neutralized by washing first with water, then with a 2% sodium carbonate solution, and further with water. The resulting Nitroglycerin should produce washings which do not color phenol-phthalein indicator and, itself, is neutral to litmus paper. This product may have a milky appearance because of its moisture content, but, on storage at normal temperature, the material becomes clear.

g) Safety Hazards:

Nitroglycerin is readily absorbed thru the skin and into the circulatory system. Inhaled vapors are absorbed by the blood. The effect is a severe & persistent headache. Some relief can be obtained by removing an affected person to fresh air, or by administering black coffee, phenacetin, asprin, caffein citrate or morphine acetate. Workers in constant contact with Nitroglycerin usually develop an immunity to its effects. The toxicity of Nitroglycerin does not appear to cause organic deterioration in workers exposed over long periods of time.

Nitroglycerin is the most hazardous explosive manufactured in relatively large quantities. Extreme precautions should be taken at all times to insure safety during its manufacture & use. Nitroglycerin, as such, is not transported by common carrier because of its extreme sensitivity to shock. A mixture of 70 parts Nitroglycerin & 30 parts acetone by weight is relatively insensitive and is sometimes transported by truck. The Nitroglycerin in such a mixture can be separated by adding water, or by evaporating the acetone with a current of air. An emulsion of 87% Nitroglycerin & 13% water that has been stabilized with methyl cellulose also has been found to be sufficiently insensitive to permit safe handling.

h) Storage:

Nitroglycerin is quite stable at temperatures below $50^{o}C$ as shown by storage tests & surveillance over a period of years. At higher temperatures, the rate of decomposition is rapid. Because of its stability, very low solubility in water & neutrality of the pure material, Nitroglycerin does not cause significant corrosion of metals. The presence of more than a trace of free acid renders Nitroglycerin quite unstable, decomposition taking place within a few days.

For purposes of quantity-distance storage, Nitroglycerin is a Class 9 explosive.

i) Demilitarization and/or Disposal Procedures:

Nitroglycerin is decomposed by adding it slowly to 10 times its weight of an 18% solution of sodium sulfide. Heat is liberated by this reaction, but this is not hazardous if stirring of the mixture is continued until solution is complete. Discard the mixture by draining it into a disposal pit and cover with earth.

m) Uses:

Nitroglycerin is used extensively in Propellants, Dynamites, some composite military high explosives, and in admixtures with non-explosive materials to form Blasting Explosives.

NITROGLYCERINE

French for Nitroglycerin.

NITROGLYZERIN

Name used in Germany & Switzerland for Nitroglycerin.

NITROGUANIDIN

German for Nitroguanidine.

NITROGUANIDINA

Italian for Nitroguanidine.

NITROKLETCHATKA or NITROTSELULOSA

Russian for Nitrocellulose.

NITROLIT (bursting charge)

A German cast-loaded explosive mixture. There is no corresponding US composition. See under German Explosives.

NITROMETRIOLO, NITROPENTAGLICERINA or METRIOLO

Italian for Metriol Trinitrate. See Metriolo under Italian Explosives.

NITRONAFTITA (bursting charge)

Italian press-loaded explosive mixture. There is no corresponding US composition. See under Italian Explosives.

NITROPENTA, NITROPENTAERITRITA or PENTRITA

Spanish for PETN. See Pentrita under Spanish Explosives.

NITROPENTA or NITROPENTAERYTHRIT

German for PETN. See Pentrit under German Explosives.

NITROPENTAGLICERINA

Italian for Metriol Trinitrate. See Metriolo under Italian Explosives.

NITROTSELULOSA or NITROKLETCHATKA

Russian for Nitrocellulose.

NITROZELLULOSE or NITROCELLULOSE

Names used in Germany and in Switzerland for Nitrocellulose.

NITRURE de PLOMB

French for Lead Azide. Also Belgian.

NITRURO de PLOMO

Spanish for Lead Azide.

NIZOL

Swiss high-explosive bursting charge.

NOBELIT

A German & Swedish permissible Ammonium Nitrate Gelatin Dynamite.

NOBÉLITE (plastic dynamite)

A French Plastic Explosive composition suitable for blasting & demolition purposes. There is no corresponding US composition. See under French Explosives.

NOUGAT or MST (bursting charge)

Italian Amatol-type explosive mixture. There is no corresponding US composition. See Nougat under Italian Explosives.

NOVIT

Swedish underwater explosive. A similar mixture was used by the Germans under the name Schiesswolle 18 or TSMV1-101, and by the Japanese under the name A(ko), Type A or Otsu-B.

NPMn (Explosif) (booster explosive)

A French PETN booster explosive mixture. There is no corresponding US composition. See Relais (Explosif pour) under French Explosives.

NT (Explosif)

A French designation for Amatol. See under French Explosives.

NTMX (Explosif) (bursting charge)

A French Ammonium Nitrate bursting charge mixture. There is no corresponding US composition. See under French Explosives.

NX (Explosif) (bursting charge)

A French Ammonium Nitrate composition similar to NTMX (Explosif). See under French Explosives.

O or OC (Explosif)

French designation for Chlorate or Cheddite-type explosives. See CSE (Explosif) under French Explosives.

OCTOGEN

German for HMX.

OCTOGÈNE

French for HMX.

OGNEPROVODNYI SHNUR

Soviet Black Powder Fuse.

OKTOGHEN

Russian for HMX.

OLIO di SGOCCIOLAMENTO

Italian Drip Oil.

OLIO ESPLOSIVO, NITROGLICERINA or TRINITROGLICERINA

Italian for Nitroglycerin. See Nitroglicerina under Italian Explosives.

ONAYAKU (bursting charge)

A Japanese castable main filler for projectiles. The composition is similar to the Soviet mixture Ruskii splav. See also under Japanese Explosives.

OSHITSUYAKU

See Koshitsu under Japanese Explosives.

ŌSHIYAKU (bursting charge)

A Japanese press-loaded main filler for armor-piercing projectiles. There is no corresponding US composition. See under Japanese Explosives.

ŌSHOKUYAKU (Army), SHIMOSE, SHIMOSE BAKUYAKU (Navy) or PIKURINSAN

Japanese for Picric Acid.

OSSONITE (mining explosive)

Italian liquid mining explosive. There is no corresponding US composition. See under Italian Explosives.

OSVETITEL 'NYIYE SOSTAVY

Soviet Illuminating Compositions. See Pirotekhnicheskiye sostavy under Soviet Explosives.

OTSU-B

See A(ko) under Japanese Explosives.

OXYPIKRINSÄURE or TRINITRORESORZIN

Swiss names for Styphnic Acid. See Trinitroresorzin under Swiss Explosives.

P (Explosif)

French designation for a Cheddite-type explosive. See Explosif P under French Explosives.

PA (bursting charge)

An Italian castable PETN explosive mixture. There is no corresponding US composition. See under Italian Explosives.

PAM (bursting explosive)

Italian high-explosive bursting charge. The composition is not reported. See under Italian Explosives.

PAN (bursting charge)

Italian high-explosive bursting charge. There is no corresponding US composition. See under Italian Explosives.

PANA (bursting explosive)

Italian high-explosive bursting charge. The composition is not reported. See under Italian Explosives.

PARAMMON (bursting charge)

A German Cheddite-type explosive developed for military purposes. There is no corresponding US composition. See under German Explosives.

PE

Spanish abbreviation for Composition C. See *Exógeno plastico* under Spanish Explosives.

PENTAERYTHRIT-TETRANITRAT or NITROPENTAERYTHRIT

Names used in Switzerland for PETN.

PENTAGLYCÉRINE TRINITRATE

French for Pentaglycerin Trinitrate. See *Trinitrate de pentaglycerine* under French Explosives.

PENTASTIT (bursting charge)

Swiss trade name for military high explosives prepared by phlegmatizing PETN with pentaerythritol tetrastearate. Aluminum may also be incorporated into the composition. There are no corresponding US compositions. See under Swiss Explosives.

PENTHRITE

French for PETN.

PENTOL

German name for Pentolite. See Füllpulver Nr 42 under German Explosives.

PENTOLITA or **PENTRITOL**

Spanish for PETN.

PENTOLITE (bursting charge)

a) Foreign Nomenclature:

Britain:	Pentolite
France:	Pentolite
Germany:	Füllpulver Nr 42, Pentol & Pentritol
Italy:	Pentritolo & Pentrol
Japan:	Pentoriru
Spain:	Pentolita & Pentritol
Switzerland:	Pentro & Pentryl

b) Origin:

Pentolite came into use by several countries during WW II, primarily as a bursting charge & as a booster-surround charge.

c) Chemical Composition:

Pentolite is a mixture of PETN & TNT in various proportions. The mixture in 50/50 proportions is the one most commonly used. Other mixtures contain a higher percentage of TNT. Wax is sometimes added as a desensitizer.

d) Characteristics:

Pentolite 50/50 is a yellow-white to light buff explosive which melts at 76°C. It has a cast density of 1.65 gm/cc. Pentolite will detonate when subjected to a temperature of 220°C for 5 seconds. Pentolite is intermediate between PETN & TNT in its sensitivity to impact. It is as brisant as Tetryl and 125% as powerful as TNT. The rate of detonation of Pentolite is 7450 meters/second at density 1.65 gm/cc.

e) Manufacturing Processes:

Pentolite is manufactured by two methods. In the slurry method, PETN is suspended by agitating it in water heated to 80°C. TNT is then added to the slurry. The TNT melts & coats the PETN particles. Upon cooling the slurry, the TNT solidifies. The coated granules are collected on a filter and dried. In the coprecipitation method, PETN & TNT are dissolved separately in acetone solutions. These solutions are mixed, and the two explosives are precipitated simultaneously by pouring the mixed solutions into water. The precipitated solid is separated and dried.

f) Storage:

50/50 Pentolite is slightly less stable than PETN, but it is of satisfactory stability and has been found to contain no excess acidity after storage at 65°C for 2 years. However, Pentolite may undergo some exudation if stored for long periods of time above 50°C. Dry Pentolite has no corrosive action on common metals, but in the presence of 0.5% moisture, it has very slight action on copper, brass & zinc.

For purposes of storage compatibility grouping and quantity-distance class, Pentolite is a Group I, Class 9 explosive.

g) Uses:

Because Pentolite is readily initiated, brisant & castable, it is used as a bursting charge, shaped charge, rocket warhead charge, and as a demolition charge. During WW II Japan used Pentolite as a bursting charge for machine-gun bullets as small as 7.7 mm in caliber.

PENTORIRU

Japanese for 50/50 Pentolite.

PENTRINITA (bursting charge)

A Spanish explosive consisting of PETN & Nitroglycerin which may be gelatinized by adding Collodion Cotton. There is no corresponding US composition. See under Spanish Explosives.

PENTRINITE (bursting explosive)

An Italian & Swiss explosive bursting charge. There is no corresponding US composition. See under Italian Explosives, and under Swiss Explosives.

PENTRIT, NITROPENTA or NITROPENTAERYTHRIT

German for PETN. See Pentrit under German Explosives and under Swiss Explosives.

PENTRITA, NITROPENTA or NITROPENTAERITRITA

Spanish for PETN. See Pentrita under Spanish Explosives.

PENTRITE, TETRANITRATO di PENTAERITRITE or TETRANITROPENTAERITRITE

Italian for PETN. See Pentrite under Italian Explosives.

PENTRITOL

German & Spanish name for Pentolite. See Füllpulver Nr 42 under German Explosives, and Pentolita under Spanish Explosives.

PENTRITOLO

Italian for Pentolite.

PENTRO or PENTRYL

Swiss names for Pentolite.

PENTROL

Italian for 50/50 Pentolite.

PENTRYL or NITRATE de TRINITROPHÉNYLNITRAMINOÉTHANOL

French high-explosive compound.

PENTYL

Swedish name for PETN.

PERCHLORATIT (demolition explosive)

A German military & industrial Cheddite-type explosive. See Cheddit under German Explosives.

PERCHLORATSPRENGSTOFFE

German Perchlorate Explosives of the Cheddite type.

PERMISSIBLE EXPLOSIVES (blasting explosives safe against firedamp & coal dust)

a) Foreign Nomenclature:

Belgium:	Explosifs SGP & Explosifs antigrisouteux
Britain:	Permitted Explosives
France:	Explosifs antigrisouteux, Explosifs de Favier & Explosifs de Sûreté (Safety Explosives)
Germany:	Schlagwettersichere Sprengstoffe, Sicherheits-dynamit (Safety Dynamites) Sicherheitssprengstoffe (Safety Explosives), Wettersichere Sprengstoffe & Wettersprengstoffe
Hungary:	Biztonsági, Engedélyezett, Kezelésbiztos, Kezelésbiztos dinamt & Sujtólégbiztos lozzer
Italy:	Esplosivi ammissibili, Esplosivi antigrisoutosi & Esplosivi di sicurezza (Safety Explosives)
Soviet Union:	Antigrisutnyiye VV (Vzryvchatyiye Veshchestva), Bezopasnyiye VV (Safety Explosives) & Predokhranitel'nyiye VV
Spain:	Explosivos antigrisú, Explosivos aprobados & Explosivos de seguridad (Safety Explosives)
Switzerland:	Same as Germany

See also AMMONIUM NITRATE DYNAMITE & DYNAMITE.

PERMITE (demolition explosive)

A Belgian Ammonium Nitrate military demolition explosive. There is no corresponding US composition. See under Belgian Explosives.

PERMONITE SGP (mining explosive)

A Belgian permissible mining explosive. There is no corresponding US composition. See under Belgian Explosives.

PERTITE, MELINITA, TRINITROFENOLO or ACIDO PICRICO

Italian for Picric Acid. See Acido picrico under Italian Explosives.

PETN or PENTAERYTHRITOL TETRANITRATE (high explosive)

a) Foreign Nomenclature:

Belgium:	Penthrite & Tetranitro-pentaérythrite
France:	Penthrite & Tetranitro-pentaérythrite
Germany:	Nitropenta, Nitropentaerythrit & Pentrit
Italy:	Pentrite, Tetranitrato di Pentaeritrite & Tetranitro-pentaeritrite
Japan:	Shoeiyaku
Soviet Union:	TEN (Tetraeritrit nitrat)
Spain:	Nitropenta, Nitropentaeritrita & Pentrita
Sweden:	Pentyl
Switzerland:	Nitropentaerythrit, Pentaerythrit-tetranitrat & Pentrit

b) Origin:

PETN was known as an explosive in 1894 when it was proposed as an addition to Propellants to raise their flammability & ease of combustion. Methods of preparing PETN w re described by L. Vignon & F. Gerin (1901), Claessen (German Patent 265025 of 1912), and A. Stettbacher (1916 & 1929). PETN was not used on a practical basis until after WW I.

c) Chemical Composition and Physical Properties:

PETN is an aliphatic nitrate having the structure

$$\begin{array}{c} \qquad\qquad CH_2.ONO_2 \\ \qquad\qquad | \\ O_2NO.H_2C-C-CH_2.ONO_2 \\ \qquad\qquad | \\ \qquad\qquad CH_2.ONO_2 \end{array}$$

Its molecular weight is 316.145 and Nitrogen content 17.72%. The compound appears as white prismatic needles which melt at 141.3^{o}C. The crystal density

c) Chemical Composition and Physical Properties (cont'd):

is 1.765 gm/cc and pressed density is 1.74 gm/cc at 40,000 psi. PETN is practically insoluble in water; very slightly soluble in methanol, ethanol, ether, carbon tetrachloride & cyclohexanol; slightly soluble in hot ethanol, hot toluene & hot benzene; and very soluble in acetone & methyl acetate.

d) Test Methods and Explosive Characteristics:

PETN is not as sensitive to impact as Nitroglycerin or Nitrocellulose, but is slightly more sensitive than RDX & Tetryl. It is less sensitive to friction than RDX. Its explosion temperature test value is 225°C (with decomposition) in 5 seconds. Various tests indicate PETN to be a highly brisant & powerful explosive. Its rate of detonation is 7300 meters/second at a pressed density of 1.70 gm/cc. In general PETN, RDX & Nitroglycerin are considered to be the most potent of the standard military explosives.

e) Manufacturing Processes:

PETN is manufactured by treating pentaerythritol with either nitric acid alone, or nitric acid followed by addition of concentrated sulfuric acid. The preferred method in the USA is with nitric acid alone. This method is accomplished by adding pentaerythritol to 96% nitric acid, with stirring, and maintaining a temperature below 25°C. After 20 minutes, this solution is added to cold water in a drowning tank. The precipitated PETN is removed by filtering and washed with water. The neutral PETN is dissolved in acetone and precipitated by adding cold water to the acetone solution. The water-wet PETN is generally not dried before use.

f) Storage:

Various tests show PETN to be more stable than Nitrocellulose or Nitroglycerin at elevated temperatures, but less stable than RDX, Tetryl or TNT. Storage at 65°C for 20 months does not cause instability or undue acidity. At ordinary temperatures or at elevated temperatures,

f) Storage (cont'd):

dry PETN does not corrode common metals. In the presence of moisture, slight corrosion of brass, cadmium & zinc occurs.

For purposes of storage compatibility grouping and quantity-distance class, PETN (wet) is a Group M, Class 9 explosive.

g) Demilitarization and/or Disposal Procedures:

PETN is decomposed by dissolving it in 8 times its weight of technical grade acetone. This solution may be burned in a large, shallow container. Another method of disposing of the PETN-acetone solution is to add 7 parts by weight of a sodium sulfide solution (1 part sodium sulfide in 2 parts water) heated to 80°C to the acetone solution warmed to 40°C. Mix the two solutions at such a rate that the acetone solution does not boil. After mixing is complete, continue to stir for 1/2 hour. Discharge the mixture into a disposal pit.

h) Uses:

PETN is used in boosters & in Detonating Fuse (Primacord). It is also used as an ingredient of Priming Compositions. PETN is used in the manufacture of Pentolite & other composite bursting charges. PETN meeting certain granulation requirements is used in Detonators & Blasting Caps.

PETN phlegmatized with wax is used as a bursting charge in small caliber Italian & Soviet Shells.

PFEIFPATRONEN

German Whistling Cartridges. See Feurwerkerei under German Explosives.

PH-SALZ or DIAMN

German for Ethylenediamine Dinitrate.

PICRATE d'AMMONIAQUE

French for Ammonium Picrate.

PICRATE AMMONICO or PICRATE d'AMMONIO

Italian for Ammonium Picrate.

PICRATO AMÓNICO

Spanish for Ammonium Picrate.

PICRATOL

See MAT under Italian & Spanish Explosives.

PICRIC ACID or TRINITROPHENOL (high explosive)

a) Foreign Nomenclature:

Britain:	Lyddite
France:	Acide picrique, Mélinite or Trinitrophénol
Germany:	Bittersäure, Füllpulver Nr 2, 5 & 24; Pikrinsäure
Hungary:	Pikrinsav & Trinitrophenol
Italy:	Acido picrico, Melinita, Pertite or Trinitrofenolo
Japan:	Oshokuyaku (Army), Pikurinsan, Shimose & Shimose Bakuyaku (Navy)
Soviet Union:	Melinit, Pikrinovaya kislota & Trinitrofènol
Spain:	Ácido pícrico, Picrinita & Trinitrofenol
Sweden:	Pikrinsyra
Switzerland:	Pikrinsäure

b) Origin:

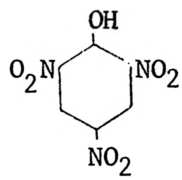
Picric Acid was first prepared in 1771 by Woulff who reacted nitric acid with indigo and obtained a yellow dye. Hausmann isolated Picric Acid in 1778. Its preparation was reported by many chemists but, in 1841, Laurent

b) Origin (cont'd):

established its identity. Picric Acid was used as a yellow dye until Turpin (1885) proposed its use as a bursting charge for high-explosive shells. The British adopted Picric Acid as a military explosive in 1888 under the name Lyddite. Other nations soon began to use it as the first melt-loaded military high explosive. Many mixtures of other explosives & Picric Acid were developed. Picric Acid & its composite explosives are still used in some foreign countries. In the USA, Picric Acid is used for the manufacture of Ammonium Picrate (Explosive D).

c) Chemical Composition and Physical Properties:

Picric Acid is an aromatic nitrocompound having the following structure:



Its molecular weight is 229.11 and Nitrogen content 18.34%. When crystallized from ethanol, it is obtained as yellow orthorhombic crystals melting at 122.5°C without decomposition. Picric Acid has a crystal density of 1.763 gm/cc, a pressed density of 1.64 gm/cc at 20000 psi, and a density of 1.71 when cast. It is slightly soluble in water at normal temperature and moderately soluble in hot water; slightly soluble in ether, carbontetrachloride & carbon disulfide; and readily soluble in hot ethanol, benzene, toluene, acetone, methanol & other solvents.

d) Test Methods and Explosive Characteristics:

Picric Acid is only slightly more sensitive to impact than TNT. The explosion temperature test value of Picric Acid (320°C) is lower than that of TNT (475°C) but higher than Tetryl (257°C). Picric Acid is equal to or superior to TNT in brisance, and it is more powerful in ballistic

d) Test Methods and Explosive Characteristics (cont'd):

pendulum & Trauzl tests than TNT. At a cast density of 1.71 gm/cc, the rate of detonation of Picric Acid is 7350 meters/second.

e) Manufacturing Processes:

Because of the violence of the reaction & low yields, Picric Acid is not prepared by the direct nitration of phenol. However, by reacting phenol with sulfuric acid to form ortho- and para-phenol sulfonic acids, these products can be nitrated to yield Picric Acid.

Another process involves the conversion of dinitrochlorobenzene into dinitrophenol and nitration of this to Picric Acid.

A catalytic process involves the refluxing of 1 part benzene with 4 1/4 parts of nitric acid in which 1/20 part of mercuric nitrate has been dissolved. Distillation of the refluxed mixture and filtering & cooling of the residue yield Picric Acid. The crude product is washed with cold water and recrystallized from hot water or benzene.

f) Safety Hazards:

Picric Acid has a strong staining action on human skin, but it is not as toxic as some other aromatic nitrocompounds. The dust from Picric Acid should not be inhaled. Frequent baths & changes of clothes are recommended for workers who manufacture, handle & load Picric Acid. If of high purity, Picric Acid is not unduly hazardous with respect to sensitivity.

g) Storage:

Picric Acid is of a high order of stability, being comparable to TNT in this respect. Long-term storage tests at normal temperatures show no evidence of measurable deterioration.

Dry Picric Acid has little effect on ordinary metals. Moist Picric Acid in contact with iron, lead, nickel, zinc & copper can form

g) Storage (cont'd):

extremely dangerous Picrates. The Picrates of lead & zinc can also be formed by contact of molten Picric Acid with the metals. These are extremely sensitive Picrates and their presence can initiate detonation of Picric Acid.

For purposes of storage compatibility grouping and quantity-distance class, Picric Acid is a Group I, Class 9 explosive.

h) Demilitarization and/or Disposal Procedures:

Picric Acid is decomposed by dissolving it in 25 times its weight of a solution made from 1 part sodium hydroxide, 21 parts sodium sulfide & 200 parts of water. During this reaction some hydrogen sulfide & ammonia are evolved. Discharge the reaction mixture into a disposal pit.

i) Uses:

Picric Acid is used as a main bursting charge & booster by the Japanese; as a booster by the Germans; and as a component of composite bursting charges by the French. In the USA, Picric Acid is used chiefly in the manufacture of Ammonium Picrate (Explosive D).

PICRIC POWDER or ABEL POWDER

A British booster explosive charge. The French use a similar composition called Brugere Poudre.

PICRINITA

Spanish for Picric Acid.

PIERRIT

Swiss Cheddite-type explosive.

PIKRAT AMMONIYA or PIKRINOVOKISLYI AMMONII

Russian for Ammonium Picrate.

PIKRINOVAYA KISLOTA, MELINIT or TRINITROFENOL

Russian for Picric Acid.

PIKRINOVOKISLYI AMMONII or PIKRAT AMMONIYA

Russian for Ammonium Picrate. See Pikrat ammoniya under Soviet Explosives.

PIKRINSÄURE

German for Picric Acid. Also Swiss.

PIKRINSYRA

Swedish for Picric Acid.

PIKURINSAN

Japanese for Picric Acid.

PIKURINSAN AMMONIA

Japanese for Ammonium Picrate.

PIOMBITE (bursting charge & mining explosive)

Italian high-explosive composition. There is no corresponding US mixture. See under Italian Explosives.

PIROKSILIN

Russian for Nitrocellulose having Nitrogen content of 12% and above.

PIROTECNIA and ARTIFIZI da GUERRA

Italian for Pyrotechnics. See Pirotecnia under Italian Explosives.

PIROTECNIAS and ARTIFICIOS

Spanish for Pyrotechnics.

PIROTEKHNICHESKIYE SIGNALY

Soviet Pyrotechnic Signals. See Pirotekhnicheskiye sostavy under Soviet Explosives.

PIROTEKHNICHESKIYE SOSTAVY, PIROTEKHNIKA and FEIVERKI

Soviet Pyrotechnic Compositions & Pyrotechnics.

PIROXILINA, NITROCELULOSA or COLODIO

Spanish for Nitrocellulose.

PLASTEX, PE or EXÓGENO PLASTICO

Spanish names for Composition C. See Exógeno plastico.

PLASTIC EXPLOSIVES (bursting charges & demolition explosives)

Foreign Nomenclature:

France:	Explosifs plastiques, Sevranite, Sofranex A & Tolamite.
Germany:	Hexoplast & Plastit
Italy:	Esplosivi plastichi
Soviet Union:	Plasticheskiye VV & Plasticheskii dinamit
Spain:	Explosivos plásticos, Plastrita, Plomoplastrita & Ploplastrita
Sweden:	Sprängdeg
Switzerland:	Gelatine-Pentrinit, Hexonit, Holtex, Pentrinit, Plastit & Plastolit

See above entries under country indicated, and also Composition C-type explosives in this section.

PLASTICHESKII DINAMIT

Soviet Plastic Dynamite. See Dinamit under Soviet Explosives.

PLASTIT

A German plastic explosive based on RDX.

PLASTIT

Swiss trade name for plastic military explosives based on PETN.

PLASTOLIT

Swiss safety Dynamite used for general blasting.

PLASTRITA

A Spanish experimental TNT paste explosive. There is no corresponding US composition. See under Spanish Explosives.

PLOPLASTRITA or PLOMOPLASTRITA (bursting charge)

A Spanish plastic explosive consisting of TNT, Collodion Cotton & lead nitrate. It was used as a bursting charge in ammunition. There is no corresponding US composition. See under Spanish Explosives.

PLUMBATOL

See Macarite under Belgian Explosives.

PLUMBAZIDA

Spanish for Lead Azide. See Nitruro de plomo under Spanish Explosives.

PNP ESPLOSIVO (bursting charge)

Italian press-loaded bursting explosive. There is no corresponding US composition. See under Italian Explosives.

POBEDIT (mining explosive)

A series of Soviet coal mining explosives which are essentially Ammonites containing 8-10% of Nitroglycerin. There are no corresponding US compositions. See under Soviet Explosives.

POLVERE BRUNA or POLVERE CIOCCOLATA

Italian for Brown Powder.

POLVERE CANNEL (blasting explosive)

Italian Cheddite-type blasting explosive. There is no corresponding US composition. See under Italian Explosives.

POLVERE NERA or POLVERE da FUOCO

Italian for Black Powder.

POLVERE VERDE (blasting explosive)

An Italian Cheddite-type blasting explosive. There is no corresponding US composition. See under Italian Explosives.

PÓLVORA NEGRA

Spanish for Black Powder.

POTENTITE or TONITE (main bursting & demolition charge)

A Belgian compressed high-explosive composition used for military demolition and for loading various projectiles. There is no corresponding US composition. See Tonite under Belgian Explosives.

POUDRE BRUNE

French for Brown Powder. See under Poudre noire under French Explosives.

POUDRE de MINE

French designate for Dynamite-type mining explosive.

POUDRE FAVIER

French Safety Explosive. See Dynamite under French Explosives.

POUDRE NOIRE

French for Black Powder.

POUDRE VERTE

A French Cheddite-type explosive.

PRIMACORD or DETONATING FUSE

See DETONATING FUSE.

PRIMING and INITIATING COMPOSITIONS (initiating agents)

a) Foreign Nomenclature:

France:	Explosifs d'amorçage
Germany:	Zündhütchensätze, Zündsprengstoffe & Initialsprengstoffe
Italy:	Esplosivi primari o innescanti
Soviet Union:	Udarnyiye & Initsiiruyushchiye sostavy
Spain:	Explosivos primarios y iniciadores
Switzerland:	Zündsprengstoffe & Initialexplosivstoffe

See above entries under country indicated, and also individual Priming & Initiating Explosives.

PTX-1

See Tetritol-Gheksoghen Brizantnoye VV under Soviet Explosives.

PYROCOLLODION

French for Nitrocellulose of 12.75% Nitrogen content.

PYROTECHNICS and (MILITARY) FIREWORKS (low explosives)

a) Foreign Nomenclature:

France:	Pyrotechnie & Artifices
Germany:	Pyrotechnik & Feuerwerkerei
Italy:	Pirotecnia & Artifizi da guerra
Soviet Union:	Pirotekhnika & Feiverki and Pirotekhnicheskiye sostavy (Pyrotechnic Compositions)
Spain:	Pirotecnia & Artificios
Sweden:	Pyroteknik
Switzerland:	Pyrotechnik & Feuerwerkerei

See above entries under country indicated.

PYROTECHNIE and ARTIFICES

French Pyrotechnics.

PYROTECHNIC and FEUERWERKEREI

German Pyrotechnics.

PYROTEKNIK

Swedish for Pyrotechnics.

PYROXYLE

French for Guncotton.

PYROXYLINE or COLLODION

French for military grade Nitrocellulose.

RAIBUN (ENKA) (primer charge)

A Japanese primer mixture also called "thunder powder". There is no corresponding US composition. See under Japanese Explosives.

RAIKŌ or RAISAN SUIGIN

Japanese for Mercury Fulminate.

RAUCHSÄTZE

German Smoke Compositions. See Feuerwerkerei & Pyrotechnik under German Explosives.

RDX, CYCLONITE or CYCLOTRIMETHYLENETRINITRAMINE (high explosive)

a) Foreign Nomenclature:

Belgium:	Hexogène or Triméthylènetrinitramine
Britain:	RDX (Research Department Explosive)
France:	Hexogène, T4 or Cyclotriméthylène-trinitramine
Germany:	E-Salz, Hexogen, K-Salz, KA-Salz, SH-Salz & W-Salz
Italy:	Exogene, T4 & Trimetilenetrinitro-ammina
Japan:	Shouyaku & Tanayaku
Soviet Union:	Gheksoghen
Spain:	Ciclonita, Exógeno & T4
Sweden:	Hexogen
Switzerland:	Hexogen

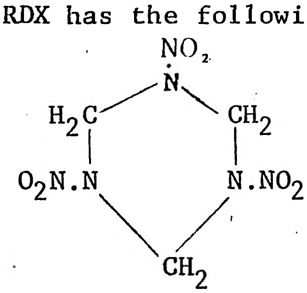
NOTE: The term RDX, although of British origin, is used interchangeably with Cyclonite in the USA.

b) Origin:

RDX was first prepared in Germany in 1899 by Henning (German Patent 104280), but it was not until 1920 that E. von Herz recognized its value as an explosive (US Patent 1402693). RDX was not used on a large scale in military ammunition until WW II.

c) Chemical Composition and Physical Properties:

RDX has the following structure:



c) Chemical Composition and Physical Properties (cont'd):

Its molecular weight is 222.13 and Nitrogen content 37.84%. It is obtained in the form of colorless orthorhombic crystals which melt at 204°C. The crystal density is 1.816 gm/cc and at 30,000 psi is compressed to a density of 1.70 gm/cc. RDX is practically insoluble in water, methanol, ethanol, ether, benzene, toluene, carbon tetrachloride & chloroform. It is readily soluble in acetone, ethyl acetate, cyclohexanone, methyl ethyl ketone, aniline & phenol. The pure compound is nonhygroscopic.

d) Test Methods and Explosive Characteristics:

Impact tests show RDX to be of the same order of sensitivity as Tetryl, but friction & rifle bullet impact tests indicate that RDX is more sensitive than Tetryl. The explosion temperature test value of RDX (260°C with decomposition) is about the same as that of Tetryl (257°C with ignition). Various brisance & power tests show that RDX & PETN are about the same in explosive power (130-160% of TNT). RDX is much less sensitive to initiation by an electric spark than Tetryl, PETN or TNT.

e) Manufacturing Processes:

RDX is manufactured by the nitration of hexamethylenetetramine, which is obtained by the reaction of formaldehyde & ammonia. By this procedure, there are formed numerous aliphatic & cyclic nitrocompounds that are present in crude RDX. The most important of these is HMX.

Nitration of hexamethylenetetramine in the presence of acetic anhydride & Ammonium Nitrate produces a product containing about 10% of HMX. Nitration with nitric acid alone produces a relatively small amount of HMX. The reaction is carried out at a temperature of 30°C or less. On cooling to 0°C, the mixture is drowned in ice water. The crude RDX is collected on a filter and washed with water. Purification of RDX is accomplished by recrystallizing it from acetone or cyclohexanone.

f) Safety Hazards:

RDX is not markedly toxic. Dry RDX causes no corrosion of metals, and, in the presence of moisture, only slight corrosion of metals occurs.

g) Storage:

At elevated temperatures, RDX is as stable as TNT. Storage for 10 months at 85°C cause no impairment in its stability or explosive properties. RDX is considered to be highly stable in long term storage at ambient temperatures.

For purposes of storage compatibility grouping and quantity-distance class, RDX (dry) is a Group L, Class 9 explosive; and RDX (wet) is a Group M, Class 9 explosive.

h) Demilitarization and/or Disposal Procedures:

RDX is decomposed by adding it slowly to 25 times its weight of a boiling 5% sodium hydroxide solution. Continue boiling for one-half hour. After cooling, dispose of the mixture by draining it into a disposal pit.

i) Uses:

RDX is used alone as a base charge in detonators, and when desensitized as a subbooster, booster & bursting charge. The principal use of RDX is in composite explosives such as Composition A, Composition B & Composition C-type explosives.

RELAIS (Explosif pour) (booster explosive)

A French PETN booster explosive composition. There is no corresponding US composition. See under French Explosives.

ROMITE (bursting explosive)

An Italian Cheddite-type bursting explosive. There is no corresponding US composition. See under Italian Explosives.

ROMPERIT 1 (mining explosive)

A German Ammonium Nitrate Dynamite used in mining. See under German Explosives.

R-SALT

See Cyclotrimethylenetrinitrosamine under French Explosives, and R-Salz under German Explosives.

R-SALZ

German name for R-Salt or Cyclotrimethylenetrinitrosamine.

RUPTOL B (mining explosive)

A current Belgian mining explosive developed and manufactured in Belgium. Similar compositions are used by several countries. See under Belgian Explosives.

RUSSKAYA SMES' (bursting charge)

A Soviet castable explosive bursting charge used as a main filler in Mines, Bombs & Shells. This mixture is also called Ruskii splav. The Japanese use a similar composition called Onayaku. There is no corresponding US mixture. See under Soviet Explosives.

RUSKII KOKTEL' (incendiary liquid)

A Soviet incendiary liquid or "Russian Cocktail" used against tanks. There is no corresponding US composition. See under Soviet Explosives.

RUSKII SPLAV (bursting charge)

See Ruskaya smes' under Soviet Explosives.

SABULITA (military & industrial explosive)

A Spanish Ammonium Nitrate explosive used for both military & industrial applications. There is no corresponding US composition. See under Spanish Explosives.

SABULITE (coal mining explosive)

A class of Belgian permissible coal-mining explosives. These compositions are also suitable for military demolition purposes. There are no corresponding US compositions. See under Belgian Explosives.

The Italians modified these compositions and used them as bursting charges. See under Italian Explosives.

SAKUMA DAINAMAITO

Japanese Dynamite.

SAKURA Nos. 1 & 2

Japanese Blasting Gelatin.

SANSHŌKI MECHIRU NITOROAMIN

Japanese for Tetryl.

SANSHŌKI TORUŌRU

Japanese for TNT.

SCHIESSBAUMWOLLE or SCHIESSWOLLE

German for Guncotton.

SCHIESSWOLLE 18 or TSMV1-101 (bursting charge)

A German castable bursting charge of aluminized Hexamit. There is no corresponding US composition. See under German Explosives.

SCHNEIDERITE (bursting & demolition explosive)

A bursting explosive composition and demolition charge used by several countries. There is no corresponding US composition. See under French & Italian Explosives, and Shneiderit under Soviet Explosives.

SCHWARZPULVER

German for Black Powder.

SÉCURITE (mining explosive)

A series of Belgian permissible explosives. Similar compositions are used by several countries. See under Belgian Explosives.

SEIGATA (Army) or TYPE 97H (Navy) (bursting charge)

A Japanese castable explosive charge used in Depth Charges, Torpedoes & Rockets. There is no corresponding US composition. See under Japanese Explosives.

SENGITE

See Tonite under Belgian Explosives.

SERANIN

Swedish Ammonium Nitrate Dynamite.

SEVRANITE (plastic explosive)

A French plastic high explosive composition. There is no corresponding US composition. See under French Explosives.

SGP

Abbreviation for Sécurité-Grisou-Poussière which in French means "safe against firedamp & coal dust". See Explosifs SGP under Belgian Explosives.

SHAKUNETSUZAI

Japanese for Thermite.

SHEDIT

Russian for Cheddite.

SHIMOSE

Japanese for Picric Acid.

SHIMOSE BAKUYAKU (Navy) or ŌSHOKUYAKU (Army)

Japanese for Picric Acid.

SHIN-KIRI

Japanese Ammonium Nitrate Gelatin Dynamite.

SHINKYORYOKU

Japanese Ammonium Nitrate Dynamite.

SHIN-TOKU-SHOAN

Japanese Ammonium Nitrate Dynamite.

SHIRAUME

Japanese Ammonium Nitrate Dynamite.

SHNEIDERIT

Russian for Schneiderite.

SHOAN BAKUYAKU

Japanese Ammonium Nitrate Dynamite.

SHOANYAKU (mining explosive & demolition charge)

A series of Japanese coal-mining explosives based on Ammonium Nitrate. There are no corresponding US compositions. See under Japanese Explosives.

SHŌBENYAKU

See Anbenyaku under Japanese Explosives.

SHOEIYAKU

Japanese for PETN.

SHOKOLADNYI POROKH or BURYI POROKH

Soviet Brown Powder.

SHONAYAKU (SHON-Ō-YAKU) (bursting charge & demolition explosive)

A Japanese high-explosive mixture used as a main charge in Shells & Mines, and in military Demolition Charges. There is no corresponding US composition. See under Japanese Explosives.

SHŌTOYAKU

Japanese for Amatol.

SHOUYAKU or TANAYAKU

Japanese for RDX.

SHOUYAKU KOSHITSU

See Koshitsu under Japanese Explosives.

SH-SALZ

One of several German names for RDX. See Hexogen under German Explosives.

SICHERHEITSDYNAMIT

German safety Dynamite.

SICHERHEITSSPRENGSTOFFE

Swiss safety explosives.

SIGNALMITTELN

German Signal Devices. See Feuerwerkerei under German Explosives.

SILVER AZIDE

See Acido d'argento under Italian Explosives.

SILVER FULMINATE

See Fulminato d'argento under Italian Explosives.

SIMPLONIT

Swiss Dynamite which is an aluminized Gamsit.

SINOXYDSATZ or SINOXYD

A Primary Explosive mixture developed in Germany. See under Tetracene under Swiss Explosives.

SIPERITE or MNDT (bursting explosive)

An Italian castable Ammonium Nitrate bursting explosive. There is no corresponding US composition. See under Italian Explosives.

SKAL'NYI AMMONIT

Soviet Ammonite used for blasting rock.

SOFRANEX A (plastic mining explosive)

A French Ammonium Nitrate plastic mining explosive. There is no corresponding US composition. See under French Explosives.

SOLFITE

Italian Ammonium Nitrate explosive mixture. There is no corresponding US composition. See under Italian Explosives.

SOSTAVY ZAMEDLENNAGO DEYSTVIYA

Soviet Black Powder Delay Compositions.

SPEZIALSPRENGGELATINE

Swiss Blasting Gelatin.

SPRÄNGÄMNEN med MINVERKAN

Swedish for Demolition Explosives.

SPRÄNGDEG

Swedish Plastic Explosive.

SPRÄNGGELATIN

Swedish for Blasting Gelatin.

SPRENGGELATIN

German Blasting Gelatine.

SPRENGKAPSEL

German Blasting Cap. See *Detonatoren- und Sprengkapseln-Ladungen* under German Explosives.

SPRENGKÖRPER 28

German name applied to pressed charges of either TNT or Picric Acid. See under German Explosives.

SPRENGNIET

A German explosive rivet using a Priming Composition sensitive to flame, impact & friction.

SPRENGÖL

German name, meaning "Explosive Oil", for Nitroglycerin. See Nitroglycerin under German Explosives.

STIFNATO di PIOMBO or TRINITRORESORCINATO di PIOMBO

Italian for Lead Styphnate. See Trinitroresorcinato di piombo.

STIFNAT SVINTSA or TRINITRORESORSINAT SVINTSA

Russian for Lead Styphnate.

STUDENISTYI DINAMIT

Soviet Gelatin Dynamite.

STYPHNATE de PLOMB or TRINITRORÉSORCINATE de PLOMB

French for Lead Styphnate.

STYPHNIC ACID

See Acido stifnico or Trinitroresorcina under Italian Explosives, and Trinitroresorzin under Swiss Explosives.

STYPHNINSÄURE

One of the Swiss names for Styphnic Acid.

SUBSTITUTE EXPLOSIVES

See Ersatzsprengstoffe under German Explosives.

SVARTKRUT

Swedish for Black Powder.

SWISS UNKNOWN NAME EXPLOSIVES

A series of Swiss patented explosives including an Ammonium Nitrate Explosive, Matter's Explosive & Tetranitromethane-Hydrocarbon Explosives.

T4, CICLONITA or EXÓGENO

Spanish for RDX. See Exógeno.

T4, TRIMETILENTRINITROAMMINA or EXOGENE

Italian for RDX. See T4.

T4 (plastico)

Italian Composition C-type explosive mixture. See under Italian Explosives.

TAKE NOS 1, 2 & 3

Japanese Ammonium Nitrate Gelatins.

TANAYAKU or SHOYAKU

Japanese for RDX.

TANŌYAKU (bursting charge)

Japanese cast-loaded high-explosive charges for projectiles. These compositions are similar to some US experimental mixtures. See under Japanese Explosives.

TELSIT

Swiss name applied to a series of Gelatin Dynamites.

TEN

Soviet designation for PETN. See Tetraeritrit nitrat under Soviet Explosives.

TERRIT

Swedish plastic Cheddite-type blasting explosive.

TETAN, TETRANITROMETHAN or X-STOFF

German names for Tetranitromethane. See Tetan under German Explosives.

TETRACENE (initiating explosive)

a) Foreign Nomenclature:

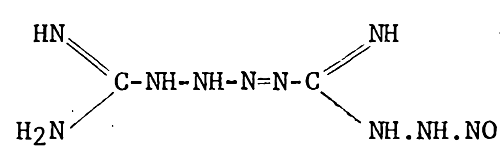
France:	Tétrazène
Germany:	Tetrazen
Italy:	Guanylnitrosoammina & Tetrazene
Soviet Union:	Tetrazen
Spain:	Tetraceno
Sweden:	Tetrazen
Switzerland:	Tetrazen

b) Origin:

Tetracene was first prepared in 1892 by J. Thiele in Germany. K.A. Hofmann & R. Roth, in 1910, studied its chemical reactions and determined its structure. W.H. Rinkenbach & O. Burton made an extensive study of Tetracene and described its manufacture & explosive properties [Army Ordnance 12, 120-123 (1931)].

c) Chemical Composition and Physical Properties:

Tetracene is an abbreviated name for the compound called 4-Guanyl-1-(nitrosoaminoguanyl)-1-tetrazene having the following structure:



It has a molecular weight of 188.16 and a Nitrogen content of 74.44%. It is obtained as colorless or pale yellow fluffy crystals which melt with explosive violence at 140-160°C. Tetracene is practically insoluble in water, ethanol, benzene, ether & carbon tetrachloride.

d) Test Methods and Explosive Characteristics:

Tetracene is as sensitive to impact as Mercury Fulminate & Diazodinitrophenol. Its explosion temperature (150°C) is lower than that of other initiating explosives. In contact with a flame, Tetracene undergoes mild explosion, producing a lot of black smoke. When properly initiated, Tetracene is as brisant as Mercury Fulminate. Tetracene is extremely sensitive to "dead pressing". The unpressed material, when ignited by a flame, can detonate PETN and cause low-order detonation of Tetryl. Pressed Tetracene does not detonate PETN.

e) Manufacturing Processes:

Tetracene is prepared by reacting aminoguanidine dinitrate in water at 0°C with an aqueous sodium nitrite solution. The temperature is maintained at 10°C and acetic acid is added. The Tetracene separates, on allowing the mixture to stand. It is collected on a filter, washed with water, alcohol & ether, and dried.

Tetracene is also prepared by reacting aminoguanidine sulfate or carbonate with sodium nitrite in the presence of acetic acid.

f) Storage:

Tetracene is relatively stable at temperatures below 75°C. Sufficient data are not available to definitely evaluate its stability in long-term storage, but it is judged to be of the order of Mercury Fulminate.

Tetracene should be stored wet with water or a mixture of water & ethanol.

Tetracene is not a standard US military explosive and, therefore, is not listed among US explosives for compatibility grouping. However, the properties of Tetracene suggest that it should be similarly classed as Lead Azide, Lead Styphnate & Mercury Fulminate; that is, a Group M, Class 9 explosive.

g) Demilitarization and/or Disposal Procedures:

Tetracene is decomposed by adding it to boiling water. Nitrogen is evolved in this decomposition. The boiling of the solution should be continued for some time to insure complete decomposition. Discharge the cooled mixture into a disposal pit.

h) Uses:

Tetracene is used as an ingredient of Primer & Detonator Compositions.

TETRACENO

Spanish for Tetracene.

TETRAERITRIT NITRAT (TEN)

Russian for PETN.

TETRALITA, TETRANITROMETILANILINA or TETRILO

Spanish names for Tetryl. See Tetralita under Spanish Explosives.

TETRALITE, TETRILE, TETRANITROMETILANILINA, or TRINITROFENILMETIL-NITROAMMINA

Italian for Tetryl. See Tetralite under Italian Explosives.

TETRANITRATO di PENTAERITRITE

Italian for PETN. See Pentrite under Italian Explosives.

TETRANITROCARBAZOL or GELBMEHL

German for Tetranitrocarbazole.

TETRANITROCARBAZOLE

See Tetranitrocarbazol under German Explosives.

TETRANITROMETHAN, TETAN or X-STOFF

German names for Tetranitromethane. See Tetan under German Explosives.

TÉTRANITROMÉTHYLAMINE

French for Tetryl. See Tétryl under French Explosives.

TETRANITROMETHYLANILIN or TETRYL

Swiss names for Tetryl.

TETRANITROMETILANILINA

Spanish for Tetryl. See Tetralita under Spanish Explosives.

TETRANITROMETILANILINA

Italian for Tetryl. See Tetralite under Italian Explosives.

TETRANITROPENTAERITRITE

Italian for PETN. See Pentrite under Italian Explosives.

TETRANITROPENTAÉRYTHRITE

French for PETN.

TETRA-SALZ

German designation for Tetramethylammonium Nitrate.

TETRAZEN

German, Soviet, Swedish & Swiss name for Tetracene.

TÉTRAZÈNE

French for Tetracene.

TETRIL

Russian for Tetryl.

TETRILE

Italian for Tetryl. See Tetralite under Italian Explosives.

TETRILO

Spanish for Tetryl. See Tetralita under Spanish Explosives.

TETRITOL

Russian & Spanish for Tetrytol.

TETRITOL-GHEKSOGHEN BRIZANTNOYE VV

Soviet PTX-1 Composition.

TETRYL (booster explosive)

a) Foreign Nomenclature:

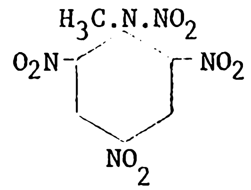
Britain:	CE (Composition Exploding)
France:	Tétryl or Tétranitrométhylamine
Germany:	Tetryl
Italy:	Tetralite, Tetranitrometilanilina, Tetrile & Trinitrofenilmetil-nitroammina
Japan:	Meiyaku & Sanshōki Mechiru Nitoroamin
Soviet Union:	Tetril
Spain:	Tetralita, Tetranitrometilanilina & Tetrilo
Sweden:	Tetryl
Switzerland:	Tetranitromethylanilin & Tetryl

b) Origin:

The preparation of Tetryl was first described by W. Michler & K. Meyer in 1879. Soon thereafter P. van Romburgh and K.H. Mertens reported their studies. The structure of Tetryl was proved by van Romburgh by synthesizing it from Picryl Chloride & potassium methylnitramine. Tetryl was not used as a military explosive until WW I.

c) Chemical Composition and Physical Properties:

Tetryl is a nitroaryl nitrocompound having the structure:



Its molecular weight is 287.15 and Nitrogen content 24.39%. Highly purified Tetryl is colorless, but it rapidly becomes light yellow-buff when exposed to light. The monoclinic crystals melt at 129.5°C with partial decomposition. Tetryl has a crystal density of 1.73 gm/cc and a pressed density of 1.67 gm/cc at 20,000 psi. Tetryl is practically insoluble in water, carbon tetrachloride, ether, carbon disulfide & trichloroethylene. It is slightly soluble in hot alcohol & chloroform, and readily soluble in acetone, ethyl acetate, benzene, toluene, xylene & ethylene dichloride.

d) Test Methods and Explosive Characteristics:

Tetryl is more sensitive than TNT as shown by the results of impact & rifle bullet tests. However, Tetryl does not explode in the friction pendulum test. In the sand test, Tetryl is readily initiated by 0.10 gram of Lead Azide or 0.20 gram of Mercury Fulminate. Tetryl is about 125% as brisant as TNT and about 85% as brisant as PETN or RDX. The rate of detonation of Tetryl pressed at 30,000 psi to a density of 1.71 gm/cc is 7850 meters/second.

e) Manufacturing Processes:

Two methods are used for the production of Tetryl. They involve the nitration of the raw materials dimethylaniline or dinitrophenylmethylamine.

In the manufacture of Tetryl from dimethylaniline, one part of this is dissolved in 14 parts of sulfuric acid at 25°C. The dimethylaniline sulfate formed is added to 9 parts of mixed acid at 70°C. The crude Tetryl which precipitates must be carefully purified. Treatment with boiling water removes any tetranitrocompound present in the product. Either benzene or acetone may be used as the solvent for final purification of the crude Tetryl.

Dinitrophenylmethylamine, obtained from dinitrochlorobenzene by reaction with aqueous monomethylamine & sodium hydroxide, is nitrated by dissolving it in sulfuric acid at 25°C, followed by adding nitric acid. The crude product is dumped into water, collected on a filter and washed with water until the washings are neutral. The Tetryl is finally recrystallized from a solvent to remove any occluded acid, other impurities, and to control its granulation.

f) Safety Hazards:

Tetryl has a strong coloring action on human skin and can cause dermatitis. A cold cream containing 10% sodium perborate has been found to minimize these effects. Inhalation of Tetryl dust should be avoided. The maximum allowable concentration of Tetryl dust in air is 1.5 milligrams per cubic meter.

g) Storage:

Tetryl has been found to withstand storage at 100°C for 100 hours, at 75°C for 6 months, at 65°C for 12 months, and at magazine temperature for 20 years without any significant impairment of its stability. Thus, the physical deterioration of Tetryl in storage is not a problem.

g) Storage (cont'd):

In the presence of 0.5% moisture, Tetryl has some corrosive effect on steel & zinc but little or no effect on other metals. It does not affect metals when they are coated with acidproof black paint, baked oil, NRC compound or shellac, even at 50°C.

For purposes of storage compatibility grouping and quantity-distance classification, Tetryl is a Group L, Class 9 explosive.

h) Demilitarization and/or Disposal Procedures:

Tetryl is decomposed by dissolving it in 12 times its weight of a solution prepared from 1 part by weight of sodium sulfite & 4 parts of water. The decomposition of Tetryl is increased if the sulfite solution is heated to 80°C. Allow the mixture to cool and discard it into a disposal pit.

i) Uses:

Tetryl is universally used as a booster explosive. It is used in some composite bursting charges, and as the base charge in some Detonators & Blasting Caps.

TETRYTOL (bursting charge)

See Tetritol under Soviet Explosives and under Spanish Explosives.

THERMITE.

See Skakunetsuzai under Japanese Explosives, and Thermitzündung under Swiss Explosives.

THERMITZÜNDUNG

Swiss Thermite Priming & Igniting Composition.

TIPO I & II DINAMITE

Italian names for two types of Dynamite. See Dinamite under Italian Explosives.

TNRS

Russian abbreviation for Trinitroresorsinat svintsa (Lead Styphnate). See Stifnat svintsa under Soviet Explosives.

TNT or TRINITROTOLUENE (high explosive)

a) Foreign Nomenclature:

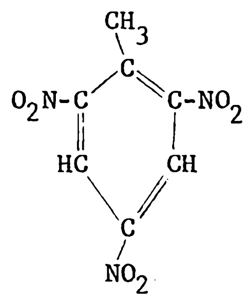
Britain:	Trotyl
Belgium:	Trinitrotoluène & Trotyl
France:	Trinitrotoluène, Trotyl & Tolite
Germany:	Trinitrotoluol & Trotyl
Hungary:	Trilit, Trinitrotoluol, Tritolo & Trotil
Italy:	Tolite, Trilite, Trinitrotolueno, Trinitrotoluolo, Trinolo, Tritolo & Trotyl
Japan:	Chakatsuyaku, Sanshōki Toruōru & Type 92 (Navy)
Soviet Union:	Tol & Trotil
Spain:	Trilita, Trinitrotolueno, Trinitrotoluol & Trotilo
Sweden:	Trotyl
Switzerland:	Trinitrotoluol & Trotyl

b) Origin:

TNT was first prepared in 1863 by J. Wilbrand, later by F.K. Beilstein & A. Kuhlberg and also F. Tiemann, each using different methods or starting materials. It was nearly 30 years later that C. Häusserman undertook its manufacture on an industrial scale. After 1901 TNT was used extensively as a military explosive. Germany became the first nation to adopt it as a standard shell filler. During WW I all the major powers of the world were using TNT, with the quantity used limited only by the available supply of toluene. Because of the general suitability of TNT for melt-loading applications and its extensive use in composite explosive mixtures, TNT is considered to be the most important military explosive known today.

c) Chemical Composition and Physical Properties:

TNT is an aryl nitrocompound having the following structure for the 2,4,6- or alpha isomer:



Its molecular weight is 227.13 and Nitrogen content 18.50%. It is obtained as colorless or light yellow rhombohedral crystals, melting at 80.75°C. Unlike some other high explosives, TNT does not undergo partial decomposition when melted. It can be melted & solidified 60 times without significant change in its freezing point. The crystal density of TNT is 1.654 gm/cc, cast density 1.56 gm/cc, and pressed density is 1.55 gm/cc at 20,000 psi. The viscosity of liquid TNT is 0.139 poise at 85°C. TNT is practically insoluble in water; slightly soluble in ether, carbon tetrachloride, carbon disulfide & alcohol; and readily soluble in acetone, chloroform, ethylene chloride, benzene, toluene, aniline & other solvents.

d) Test Methods and Explosive Characteristics:

TNT is one of the least sensitive military high explosives; only Ammonium Nitrate, Ammonium Picrate & Nitroguanidine are less sensitive. Its sensitivity to impact test value is 14 inches. It is unaffected in friction pendulum tests, and explodes in only 2% of trials when subjected to the rifle bullet impact test. The explosion temperature test value of TNT is 475°C in 5 seconds.

TNT has the same brisance as Picric Acid & Guncotton and is superior, in this respect, to Ammonium Picrate & Nitroguanidine. The rate of

d) Test Methods and Explosive Characteristics (cont'd):

detonation of TNT is relatively low, 6900 meters/second at density 1.56 gm/cc, in comparison with other standard high explosives. As judged by power tests, TNT is more powerful than Ammonium Picrate but less so than Picric Acid & other standard explosives. TNT can be detonated by a No 6 Electric Blasting Cap. The fine dust of TNT is sensitive to initiation by electric sparks. When ignited in open air, TNT burns completely without detonation.

e) Manufacturing Processes:

TNT can be manufactured by one-, two-, or three-stage nitration processes. Toluene and mixed acids are the raw materials in all processes. All three processes have been used on a production basis. The continuous process, as employed by the Bofors Company of Sweden, is coming into wide usage.

In the one-stage process, a large excess of strong mixed acid is used and the temperature is gradually raised. TNT is produced in this process without transfer or separation of spent acid from the intermediate products. In the two-stage process, either mononitrotoluene or Dinitrotoluene is produced in the first stage, and TNT in the second stage. In the three-stage process, by the use of three different acid mixtures & different temperatures, there are successively produced mononitrotoluene, Dinitrotoluene & Trinitrotoluene. The three-stage process has the advantages of maximum yield, greater purity of product and greater control of acid concentration & temperature conditions. The continuous process employs the same raw materials, but operates on a "continuous" basis rather than on a "batch" basis.

The TNT resulting from any of the above processes must be purified, granulated, screened & dried. In the past, solvents such as ethanol, carbon tetrachloride & sulfuric acid were used to purify crude TNT by recrystallization.

e) Manufacturing Processes (cont'd):

Today, chemical purification by means of the "sellite" process (an aqueous solution of sulfite containing a small amount of sodium hydrogen sulfite) is replacing the crystallization process from solvents.

f) Safety Hazards:

TNT is highly toxic if absorbed into the body thru the skin or if dust & fumes are inhaled over long periods of time. In most cases of severe poisoning, there is liver damage, and jaundice may result if exposure to TNT is not detected & properly treated. A concentration of 0.5 milligram per cubic meter of air is the maximum allowable if undue exposure is to be avoided.

Alkalies, alkoxides & ammonia react with TNT to form dangerously sensitive compounds. A mixture of TNT & solid potassium hydroxide bursts into a flame when heated to 80°C. Potassium methylate & TNT react to yield a dark red powder, which has been reported to explode spontaneously on standing at room temperature. Exposure of TNT to sunlight or ultraviolet light causes progressive discoloration & decomposition with an increase in sensitivity to impact.

Liquid TNT is much more sensitive to impact than solid TNT, and under certain conditions molten TNT may be an extremely hazardous material.

g) Inspection Procedures:

TNT, as well as other bulk high explosives & Black Powder, should be examined annually to see that the containers are in good condition, that no containers are open, and that the explosive is not sifting from the container.

g) Inspection Procedures (cont'd):

TNT-loaded shell should be examined for any evidence of exudation. The exudate is a brown oily liquid that oozes out around the threads at the nose of shells. It is flammable and represents a fire hazard. Exudation of TNT-loaded shell also causes cavitation in the charge and in some cases desensitization of the booster charge.

h) Storage:

TNT can withstand storage at magazine temperature for 20 years without any measurable deterioration. TNT must have a minimum freezing point of 80.2^{o}C if exudation of shell, in storage at 50^{o}C, is to be avoided. The freezing point of TNT must be greater than 80.4^{o}C if exudation at 65^{o}C is to be prevented.

Moisture has no effect on the stability of TNT. It can be immersed in sea water without being significantly affected in any way. TNT may cause slight corrosion of lead, but it has no corrosive effect on other metals or on coatings of shellac, acidproof black paint or bakelite.

For purposes of storage compatibility grouping & quantity-distance classification, TNT is a Group I, Class 9 explosive.

i) Demilitarization and/or Disposal Procedures:

TNT is decomposed by adding it slowly, while stirring, to 30 times its weight of a solution of 1 part sodium sulfide in 6 parts of water. Discharge the mixture into a disposal pit.

Large quantities of TNT should be destroyed by burning. The explosive should be spread in a layer not more than 3 inches thick. A train of flammable material should be used to ignite the explosive. No attempt should be made to burn TNT or any other high explosive in lumps or piles.

j) Uses:

TNT is universally used as a bursting charge in Shells, Mines, Bombs & Grenades. It is used to a limited extent in industrial & military Blasting & Demolition Explosives. TNT is used in a large number of composite explosives, either to render them castable mixtures or to extend the supply of more expensive explosives. Some use of TNT in Detonating Fuses has been reported.

TOKU-SHIRAUME Nos 1 & 2

Japanese Ammonium Nitrate Gelatin.

TOL or TROTIL

Russian for TNT.

TOLAMITE (plastic mining explosive)

A French Ammonium Nitrate plastic mining explosive. There is no corresponding US composition. See under French Explosives.

TOLITE

Italian & French for TNT. See Tritolo under Italian Explosives & Tolite under French Explosives.

TOLUOL-AMMONAL

Italian name for Ammonal. See Ammonal under Italian Explosives.

TONITA (bursting charge)

A Spanish high explosive burstingcharge. There is no corresponding US composition. See under Spanish Explosives.

TONITE or POTENTITE

See Tonite under Belgian Explosives.

TORPEX (bursting charge)

Foreign Nomenclature:

Britain:	Torpex
Germany:	Tritolital
Italy:	Tritolital
Spain:	Torpex & Tritolital
Sweden:	Hexotonal

See above entries under the country indicated.

TOTALIT (bursting charge)

Swiss Ammonium Nitrate bursting charge. There is no corresponding US composition. See under Swiss Explosives.

TRACER COMPOSITION

See Composizione tracciante under Italian Explosives.

TRASSIRUYUSCHIYE SOSTAVY

Russian for Tracer Compositions. See under Pirotekhnicheskiye sostavy.

TRIALEN

German designation for Torpex-type explosive mixtures. See under German Explosives.

TRIALEN 105 (bursting explosive)

Italian castable explosive mixture. This mixture, similar in composition to Torpex, is used by several countries. See under Italian Explosives and Trialen under German Explosives.

TRICINATO or TRIGINATO

Spanish for Lead Styphnate. See Trinitroresorcinato de plomo under Spanish Explosives.

TRIDITA (bursting charge)

Spanish name for a castable mixture of Picric Acid & Dinitrophenol. The British use a similar mixture called Nellite, the French mixture is called DD (Explosif), and the Italian MBT.

TRIDITE (bursting charge)

See DD (Explosif) under French Explosives, MBT under Italian Explosives and Chaoyaku under Japanese Explosives.

TRILITA

One of several Spanish names for TNT.

TRILITE

Italian for TNT. See Tritolo under Italian Explosives.

TRIMÉTHYLÈNETRINITRAMINE or HEXOGÈNE

French for RDX.

TRIMETHILENTRINITROAMMINA, T4 or EXOGENE

Italian for RDX. See T4 under Italian Explosives.

TRIMÉTHYLÈNETRINITROSAMINE

French for R-Salt.

TRINITRATE de PENTAGLYCÉRINE

French for Pentaglycerin Trinitrate.

TRINITROANISOL or TRISOL

Names used in Switzerland for Anisole.

TRINITROANISOLE

See Trinitroanisolo under Italian Explosives, and Trinitroanisol or Trisol under Swiss Explosives.

TRINITROANISOLO

Italian for Trinitroanisole.

TRINITROBENZOL

German for Trinitrobenzene.

TRINITROCHLORBENZOL

German for Trinitrochlorobenzene.

TRINITROFENILMETILNITROAMMINA

Italian for Tetryl. See Tetralite under Italian Explosives.

TRINITROFENOL

Russian & Spanish for Picric Acid. See Pikrinovaya kislota under Soviet Explosives, and Picrinita under Spanish Explosives.

TRINITROFENOLO

Italian for Picric Acid. See Acido picrico under Italian Explosives.

TRINITROGLICERINA

Italian for Nitroglycerin. See Nitroglicerina under Italian Explosives.

TRINITRO-meta-CRESOLO

Italian name for Cresylite. See Cresilite under Italian Explosives.

TRINITRO-meta-XYLENE

See Xylite under French Explosives, and Ksilil (or Xylyl) under Soviet Explosives.

TRINITRO-méta-XYLÈNE

French for Trinitro-meta-xylene. See Xylite under French Explosives.

TRINITROMETHAN or NITROFORM

German for Trinitromethane or Nitroform. See Nitroform under German Explosives.

TRINITROMETHANE

See Nitroform under German Explosives.

TRINITROPHENETOLE

See Keineyaku under Japanese Explosives.

TRINITROPHÉNOL, MÉLINITE or ACIDE PICRIQUE

French for Picric Acid. See Mélinite under French Explosives.

TRINITRORESORCINA or ACIDO STIFNICO

Italian for Styphnic Acid. See Acido stifnico under Italian Explosives.

TRINITRORÉSORCINATE de PLOMB

French for Lead Styphnate.

TRINITRORESORCINATO de PLOMO

Spanish for Lead Styphnate.

TRINITRORESORCINATO di PIOMBO

Italian for Lead Styphnate.

TRINITRORESORSINAT SVINTSA

Russian for Lead Styphnate. See Stifnat svintsa under Soviet Explosives.

TRINITROTOLUÈNE, TROTYL or TOLITE

French and Belgian for TNT. See Tolite under French Explosives.

TRINITROTOLUENO, TRINITROTOLUOL, TROTILO or TRILITA

Spanish names for TNT. See Trilita under Spanish Explosives.

TRINITROTOLUENO, TRINITROTOLUOLO or TRINOLO

Italian names for TNT. See Tritolo under Italian Explosives.

TRINITROTOLUOL

One of several Spanish names for TNT. See Trilita under Spanish Explosives.

TRINITROTOLUOL or TROTYL

German & Swiss names for TNT.

TRINITROXYLENE

See Xylite under French Explosives and Ksilil under Soviet Explosives.

TRINOLO

Italian name for TNT. See Tritolo under Italian Explosives.

TRISOL or TRINITROANISOL

Swiss names for Anisole.

TRITOLITA

Spanish name for an explosive which corresponds to US 50/50 Cyclotol.

TRITOLITAL

German name for a Torpex-type explosive.

TRITOLITAL

Italian & Spanish name for Torpex.

TRITOLITE

Italian name for Composition B.

TRITOLO

Italian for TNT.

TRIWESTFALIT SN or ENERGIT

German industrial mining explosive. See Energit under German Explosives.

TROTIL or TOL

Russian for TNT. See Tol under Soviet Explosives.

TROTILO

One of several Spanish names for TNT. See Trilita under Spanish Explosives.

TROTYL

Italian, French, German & Swedish for TNT. See Tritolo under Italian Explosives; Tolite under French

TROTYL (cont'd)

Explosives; Trinitrotoluol under German Explosives; and Trotyl under Swedish Explosives.

TSMV 1-101 or SCHIESSWOLLE 18

German castable bursting charge. See Schiesswolle 18 under German Explosives.

TYPE A (EXPLOSIVE)

See A(ko) under Japanese Explosives. This same composition is used by the Germans under the names Schiesswolle 18, NTD2 & TSMV 1-101.

TYPE K (EXPLOSIVE)

See under Japanese Explosives.

TYPE 1 (EXPLOSIVE) (main high explosive charge)

A Japanese explosive filler for Depth Bombs. There is no corresponding US composition. See under Japanese Explosives.

TYPE 1 MK5, P5 (bursting charge)

A Japanese press-loaded filler for Depth Charges. There is no corresponding US composition. See under Japanese Explosives.

TYPE 1 MK6, P6 (bursting charge)

A Japanese press-loaded filler for Depth Charges. There is no corresponding US composition. See under Japanese Explosives.

TYPE 2 EXPLOSIVE (incendiary shell filler)

See B4 Incendiary or Type 2 (Explosive) under Japanese Explosives.

TYPE 4 (Navy) (bursting charge)

A Japanese press-loaded filler for Depth Charges. There is no corresponding US composition. See under Japanese Explosives.

TYPE 4 Mk 1 to Mk 7 (bursting charge)

A series of Japanese Navy press-loaded fillers used in Mines & Depth Charges. There are no corresponding US compositions. See under Japanese Explosives.

TYPE 88 (Navy) or KARITTO (Army)

See under Japanese Explosives.

TYPE 88 (KO) or HAENSOSAN BAKUYAKU

See under Japanese Explosives.

TYPE 91 (Navy)

Japanese designation for Trinitroanisole. See under Japanese Explosives.

TYPE 92 (Navy)

Japanese designation for TNT. The name is also applied to a Tritonal-type mixture used in projectiles. See under Japanese Explosives.

TYPE 94M (Navy) (main filler & booster charge)

A Japanese castable filler used in shaped charge Grenades and as a Booster surround. There is no corresponding US composition. See under Japanese Explosives.

TYPE 97H (Navy)

See Seigata under Japanese Explosives.

TYPE 98 (Army & Navy)

See H_2 Kongo under Japanese Explosives.

UDARNYIYE or INITSIIRUYUSHCHIYE SOSTAVY

Soviet Primer & Initiating Compositions.

UMBRITE (bursting explosive)

An Italian high-explosive mixture. There is no corresponding US composition. See under Italian Explosives.

UNDERWATER EXPLOSIVES

See *Unterwassersprengstoffe* under German Explosives.

UNKNOWN NAME EXPLOSIVES

See under Japanese Explosives. See under Italian Explosives. See under Swiss Explosives.

UNTERWASSERSPRENGSTOFFE

German Underwater Explosives.

UREA NITRATE

See *Nitrate d'urée* under French Explosives.

VERGE EXPLOSIVSTOFFE

Swiss-patented Dynamites. See under Swiss Explosives.

VIBRITE (blasting explosive)

Italian Ammonium Nitrate blasting explosives. There is no corresponding US composition. See under Italian Explosives.

VICTORITE (blasting explosive)

Italian Cheddite-type blasting explosive. There is no corresponding US composition. See under Italian Explosives.

VIRITE (blasting explosive)

Italian Black Powder-type explosive mixture. There is no corresponding US composition. See under Italian Explosives.

WESTFALIT

German Dynamite.

WETTER-DYNAMIT

One of several German Permissible Dynamites. See Wettersprengstoff under German Explosives for other Dynamites which belong to this class. See also Wetter dinamite under Italian Explosives.

WETTERSPRENGSTOFF

German coal mining explosive corresponding approximately in composition to US "Permissible Explosives" & French "Explosifs Antigrisouteux."

X-STOFF

German name for Tetranitromethane. See Tetan under German Explosives.

XYLYL or KSILIL

Russian for Trinitroxylene. See Ksilil under Soviet Explosives.

XYLITE or TRINITRO-meta-XYLENE

French for Trinitro-méta-xylène. See Xylite under French Explosives.

YONCKITE (blasting & demolition explosive)

A series of Belgian high-explosive compositions based on Ammonium Perchlorate. These explosives of the Cheddite type have been used for military demolition purposes and as main burster charge in some ammunition. See under Belgian Explosives.

YUENYAKU or KOKOSHOKUYAKU

Japanese names for Black Powder.

ZAZHIGAIEL 'NYIYE SOSTAVY

Soviet Incendiary Compositions. See under Pirotekhnicheskiye sostavy.

ZHELATIN DINAMIT or STUDENISTYI DINAMIT

Russian for Gelatin Dynamite.

ZHIROVA VZRYVCHATYIYE VESHCHESTVA

Soviet HE mixtures called Zhirov's Explosives.

ZHIROV'S EXPLOSIVES

See Zhirova VV under Soviet Explosives.

ZÜNDHÜTCHENSÄTZE & INITIALSPRENGSTOFFE

German Priming & Initiating Compositions.

ZÜNDSPRENGSTOFFE & INITIALEXPLOSIVSTOFFE

Swiss Priming and Initiating Explosives.

Belgian Explosives

Although Belgium is a small country, its explosive and ammunition industry is quite large. Belgian small arms are famous throughout the world. Due to an extensive mining industry, this country has developed, since 1870, a large number of excellent mining explosives.

Little information is available concerning current military explosives. It appears that TNT is the principal explosive used for loading various kinds of ammunition. There is little information in regard to the extensive use of either PETN or RDX in explosive compositions.

The principal explosives known to be used are listed alphabetically in the following pages.

Alkalite — ALKALITE ; AMMONIUM NITRATE DYNAMITE

One of the current industrial explosives consisting of Ammonium Nitrate 59.0%, TNT 12.5%, potassium nitrate 2.0%, aluminum 0.5% & sodium chloride (salt) 26.0%. If a sheath (gaine in French) is used, it consists of 140 gm of sodium bicarbonate per 100 gm of Alkalite. It is manufactured by the SA Fabrique Nationale de Produits Chimiques et d'Explosifs (Boncelles).

Alsilite — ALSILITE; AMMONIUM NITRATE DYNAMITE

One of the current mining explosives of the "explosifs brisants" type consisting of Ammonium Nitrate 80%, TNT 18% & aluminum 2%.

Arionite — ARIONITE ; DYNAMITE

One of the current "explosifs de sécurité renforcée" (type 4) consisting of sodium nitrate 55.6%, ammonium chloride 34.4%, Nitroglycerin 9% & Nitrocellulose 1%. This commercial mining explosive is manufactured by SA d'Arendonk (Arendonk).

Azoture de plomb or Nitrure de plomb — LEAD AZIDE

Used as a primary charge in the base detonator of Rocket Warheads.

Bellite — AMMONIUM NITRATE DYNAMITE ; BELLITE

A series of mining explosives originally invented in Sweden but used in several other countries. Two compositions also suitable for military purposes are: No 1 - Ammonium Nitrate 80% & m-Dinitrobenzene 20%; and No 3 - Ammonium Nitrate 93% & mononitrobenzene 7%.

Bicarbite — BICARBITE ; DYNAMITE

A current "explosifs de sécurité renforcée"(Type 4) consisting of sodium bicarbonate 85%, Nitroglycerin 14.9% & Nitrocellulose 0.1%. It is a commercial mining explosive manufactured by SA d'Arendonk (Arendonk).

AMMONIUM NITRATE DYNAMITE
CENTRALITE RII & TA

Centralite RII & TA

One of the permissible explosives consisting of Ammonium Nitrate 62% (or Ammonium Nitrate 42% & Potassium Perchlorate 20%), TNT 14%, sodium chloride (salt) 18% & sodium oxalate 6%. This composition was used prior to WW II. A current "explosif brisant" consists of Ammonium Nitrate 79.5%, TNT 14.5%, RDX 2.0%, Dinitrotoluene 1.0% & aluminum 3.0% (Centralite TA).

Charbrite

CHARBRITE ; DYNAMITE

One of the current "explosifs de sécurité renforcée" (type 4) consisting of sodium nitrate 54.5%, ammonium chloride 34.0%, Nitroglycerin 10%, woodpulp 1% & soap (containing copper sulfate) 0.5%. An alternate charge consists of sodium nitrate 54.7%, ammonium chloride 33.3%, Nitroglycerin 10%, kieselguhr 1.5% & soap (containing copper sulfate) 0.5%. This commercial mining explosive is manufactured by the SA Poudreries Réunies de Belgique (Matagne-la-Grande, Ben-Ahin, Clermont-sous-Huy, Engis & Balen).

Cooppalite

COOPPALITE ; DYNAMITE

One of the current "explosifs SGP" consisting of sodium chloride 42%, Ammonium Nitrate 21.5%, Nitroglycerin/Nitroglycol 35% & Nitrocellulose 1.5%. This commercial mining explosive is manufactured by the SA de la Poudrerie Royale de Wetteren Cooppal & Cie (Caulille & Wetteren).

Coton-poudre No 1

GUNCOTTON

Dynamite III

DYNAMITE

A current industrial explosive consisting of Ammonium Nitrate 62.0%, Nitroglycerin 26.0%, Dinitrotoluene 9.5%, woodflour 1.3% & Nitrocellulose 1.2%. See also Cooppalite and Sécurite.

AMMONIUM NITRATE DYNAMITE
EXPLOSIFS BRISANTS

Explosifs brisants

Current industrial explosives based on Ammonium Nitrate as the principal ingredient. Some specific compositions are given under the names Alsilite, Centralite RII, Centralite TA, Cooppalite, Fractorite, Ruptol B & Sabulite 003.

AMMONIUM NITRATE DYNAMITE
EXPLOSIFS de FAVIER

Explosifs de Favier

Permissible Ammonium Nitrate explosives were introduced in the 1880's but have been modified and improved since that time. Some recent & current compositions are as follows:

Favier 2: Ammonium Nitrate 81%, dinitronaphthalene 12% & ammonium chloride 7%.

Favier 2 bis Vilvorde: Ammonium Nitrate 77.6%, dinitronaphthalene 2.4% & ammonium chloride 20.0%.

Favier 3 bis: Ammonium Nitrate 60.0%, potassium nitrate 11.0%, ammonium chloride 4.0%, TNT 8.5%, flour 6.0%, alum 5.0%, barium carbonate 5.0% & potassium permanganate 0.5%.

Favier 4: Ammonium Nitrate 95.5% & dinitronaphthalene 4.5%.

Favier Antigrisouteux: Ammonium Nitrate 81%, dinitronaphthalene 6% & ammonium chloride 13%.

AMMONIUM NITRATE DYNAMITE
EXPLOSIFS SGP

Explosifs SGP (Sécurité-Grisou-Poussière)

A class of blasting explosives permitted for use in coal mines. They are usually based on Ammonium Nitrate as the principal ingredient and are somewhat similar to Ammonite. See Alkalite, Alsilite, Bellite, Centralite RII & TA, Cooppalite, Explosifs de Favier, Flammivore, Fractorite CA, Matagnite, Nitrocooppalite, Permite, Permonite SGP, Sabulite, Tonite, Ruptol.

AMMONIUM NITRATE DYNAMITE
FLAMMIVORE

Flammivore

A current industrial safety explosive consisting of Ammonium Nitrate 59.45%, Nitroglycerin 10.00%, woodflour 6.50%, Dinitrotoluene 1.00%, Nitrocellulose 0.05% & sodium chloride (salt) 23.00%. This explosive is packed into a cartridge and sheathed with a mixture of sodium bicarbonate 90% & cement 10% per 100 gm of Flammivore.

AMMONIUM NITRATE DYNAMITE
FLAMMIVORE

Flammivore (Arendonk)

One of the current "explosifs SGP" consisting of Ammonium Nitrate 58%, Nitroglycerin/glycol 10%, woodflour 7% & sodium chloride (salt) 25%. This commercial mining explosive is manufactured by the SA d'Arendonk (Arendonk).

Forcite & Forcite Extra — FORCITE, GELATIN DYNAMITE

An Ammonium Nitrate Gelatin explosive used in underground quarrying, mining & tunneling operations, but not permitted in gaseous coal mines. See Table 6 under AMMONIUM NITRATE.

Fractorite CA — AMMONIUM NITRATE DYNAMITE, FRACTORITE CA

One of the current "explosifs brisants" consisting of Ammonium Nitrate 77%, TNT 10%, Nitroglycerin 10%, kieselguhr 1.5%, woodflour 1.0% & soap (containing copper sulfate) 0.5%. This commercial mining explosive is manufactured by the SA Poudreries Réunies de Belgique (Matagne-la-Grande, Ben-Ahin, Clermont-sous-Huy, Engis & Balen).

Fulminate de mercure — MERCURY FULMINATE

Used in primer charge mixtures, for example: Potassium Chlorate 57%, Mercury Fulminate 11% & antimony sulfide 32%.

Hexogène or Triméthylène-trinitramine — RDX

Macarite — MACARITE

A castable, main high-explosive charge consisting of lead nitrate 70% & TNT 30%. This mixture has a density of 2.89 gm/cc; brisance 68% of TNT; explosion temperature 238 $^{\circ}$C (decomposing in 5 seconds); and rate of detonation 4850 meters/sec. This same composition is known in Britain & USA as Plumbatol.

Matagnite — AMMONIUM NITRATE DYNAMITE, MATAGNITE

A current industrial explosive of the "explosif SGP" type. It consists of Ammonium Nitrate 60%, Nitroglycerin/glycol 10%, woodflour 7% & sodium chloride (salt) 23%. It is packed in a cartridge and sheathed with 140 gm of sodium bicarbonate per 100 gm of Matagnite. This commercial mining explosive is manufactured by the SA Poudreries Réunies de Belgique (Matagne-la-Grande, Ben-Ahin, Clermont-sous Huy, Engis & Balen).

Minolite antigrisouteuse — AMMONIUM NITRATE DYNAMITE, MINOLITE ANTIGRISOUTEUSE

A current permissible explosive consisting of Ammonium Nitrate 72%, sodium nitrate 23%, TNT 3% & Trinitronaphthalene 2%.

Nitrate d'ammoniaque — AMMONIUM NITRATE

Used in a wide variety of commercial explosives and military Demolition Charges. See AMMONIUM NITRATE DYNAMITE and also Dynamite & Explosifs SGP.

Nitroboncellite — AMMONIUM NITRATE DYNAMITE, NITROBONCELLITE

One of the current "explosifs SGP" consisting of the same composition as Nitrocooppalite V. This commercial mining explosive is manufactured by the SA Fabrique Nationale de Produits Chimiques et d'Explosifs (Boncelles).

Nitrocooppalite V — AMMONIUM NITRATE DYNAMITE, NITROCOOPPALITE V

One of the current industrial "explosifs SGP" consisting of Ammonium Nitrate 60%, Nitroglycerin 10%, woodflour 7% & sodium chloride 23%. The sheath consists of 140 gm sodium bicarbonate per 100 gm of explosive. This mixture is similar in composition to Flammivore (Arendonk). This commercial mining explosive is manufactured by the SA de la Poudrerie Royale de Wetteren Cooppal & Cie (Caulille & Wetteren). See also Nitrocooppalite VIII.

Nitrocooppalite VIII — DYNAMITE, NITROCOOPPALITE VIII

One of the current "explosifs de sécurité renforcée" (type 4) consisting of sodium nitrate 55.50%, Nitroglycerin 10.11%, ammonium chloride 34.30% & Nitrocellulose 0.09%. This commercial mining explosive is manufactured by the same company that makes Nitrocooppalite V.

Nitroglycérine — NITROGLYCERIN

Used in a wide variety of commercial explosives & military Demolition Charges. See AMMONIUM NITRATE DYNAMITE, AMMONIUM NITRATE, GELATIN DYNAMITE and DYNAMITE.

Nitrure de plomb or Azoture de plomb — LEAD AZIDE

See Lead Azide.

Penthrite or Tetranitropenta-erythrite — PETN

A mixture of 92.5% PETN & 7.5% wax (unidentified) compressed in pellets to a density of 1.60 gm/cc is used as the main charge in Rocket Warheads. The same mixture compressed in pellets is also used as a Booster Charge.

Permite — AMMONIUM NITRATE DYNAMITE PERMITE

A dark-gray blasting explosive consisting of Ammonium Nitrate 78%, TNT 8% & calcium silicide 14%. This composition can be readily initiated by standard service Detonators. It has been used for military demolition purposes.

Permonite SGP — AMMONIUM NITRATE DYNAMITE PERMONITE SGP

One of the permissible explosives consisting of Ammonium Nitrate 29.0%, Potassium Perchlorate 24.5%, Nitroglycerin 6.0%, TNT 7.0%, sodium chloride (salt) 24.5%, flour 5.0%, woodflour 3.0% & jelly 1.0%. This mixture has a gap test value of 100 mm; power by Trauzl test 205cc; rate of detonation 2326 meters/sec; and sensitivity to impact 80 cm with a 2 kg weight (comparable to TNT).

Potentite or Tonite — TONITE

See Tonite.

Poudre brune — BROWN POWDER

This composition consists of potassium nitrate 80%, reddish-brown charcoal 17% & sulfur 3%. It is presumably used as a substitute for Black Powder.

Poudre noire — BLACK POWDER

Standard compositions are as follows: Blasting Powder (made at Wetteren Factory) potassium nitrate 70%, carbon 14% & sulfur 16%. Blasting Powder (made at Ombret Factory) potassium nitrate 73.5%, carbon 12.5% & sulfur 14%.

Service Powder (military grade) potassium nitrate 80%, carbon 17% & sulfur 3%.

Sporting Powder potassium nitrate 78%, carbon 14% & sulfur 8%.

AMMONIUM NITRATE DYNAMITE
RUPTOL B

Ruptol B

One of the current "explosifs brisants" consisting of Ammonium Nitrate 74.5%, Nitroglycerin 10%, Dinitrotoluene 4%, woodflour 6.5% & sodium chloride (salt) 5%. This commercial mining explosive is manufactured by the SA d'Arendonk (Arendonk).

AMMONIUM NITRATE DYNAMITE
SABULITE

Sabulite

A permissible coal mining explosive consisting of Ammonium Nitrate 51%, Ammonium Perchlorate 10%, TNT 15% & sodium chloride (salt) 24%. The limiting charge, in use, is 850 gm (equivalent to 531 gm of Dynamite No 1 which is Nitroglycerin 75% & kieselguhr 25%).

Other compositions, by the same name, consist of a) Ammonium Nitrate 52%, Trinitronaphthalene 9%, Potassium Perchlorate 9%, TNT 4% & sodium chloride (salt) 26%. This explosive may be used with a sheath (110 gm) of sodium bicarbonate 95% & cement 5% per 100 gm of Sabulite. b) Ammonium Nitrate 58.5%, TNT 14%, Potassium Perchlorate 5%, Trinitronaphthalene 1%, woodflour 1.5% & sodium chloride (salt) 20% ("explosif SGP"). c) Sabulite 003 - Ammonium Nitrate 80%, TNT 14.2%, woodflour 1.8% & calcium silicide 4% ("explosif brisant").

These commercial mining explosives are manufactured by the SA La Sabulite Belge (Moustier-sur-Sambre).

See also under Italian Explosives.

DYNAMITE
SÉCURITE

Sécurite

Some current mining dynamites of the "explosifs SGP" type include:
Sécurite B - Ammonium Nitrate 23.5%, Nitroglycerin/glycol 35%, Nitrocellulose 1.5% & sodium chloride (salt) 40%. This composition is manufactured by the SA d'Arendonk (Arendonk) and by the SA Poudreries Réunies de Belgique (Matagne-la-Grande, Ben-Ahin, Clermont-sous-Huy, Engis & Balen).
Sécurite C - Ammonium Nitrate 26.5%, Nitroglycerin 29.0%, Dinitrotoluene 3.0%, Nitrocellulose 1.0%, woodflour 0.5% & sodium chloride (salt) 40.0%.
Sécurite G - Ammonium Nitrate 18.75%, Nitroglycerin 30.00%, Dinitrotoluene 5.00%, Nitrocellulose 1.25% & sodium chloride 45.00%.
See also Dynamite III.

Sengite — TONITE

See Tonite.

SGP (Sécurité-Grisou-Poussière) — EXPLOSIFS SGP

See Explosifs SGP.

Means safe against firedamp & coal dust. This designation is used for permissible explosives.

Tetranitropentaérythrite or Penthrite — PETN

Tonite, Potentite or Sengite — TONITE

A high-explosive composition consisting of Guncotton (pulped) 53.0%, barium nitrate 37.6% & sodium nitrate 9.4%. This mixture was compressed into blocks & cylinders and used either for military Demolition Charges or for loading various projectiles.

A Tonite in which sodium nitrate is used in lieu of barium nitrate is called Sengite.

Triméthylènetrinitramine or Hexogène — RDX

Trinitrorésorcinate de plomb — LEAD STYPHNATE

Used as one of charges in the base detonator of a Rocket Warhead.

Trinitrotoluène or Trotyl — TNT

Used straight as a main charge in various items of ammunition, and as an ingredient of commercial & military Demolition Charges.

Yonckite — CHEDDITE ; YONCKITE

This name is applied to a series of high-explosive mixtures based on Ammonium Perchlorate. One current composition consists of Ammonium Perchlorate 43%, sodium nitrate 32%, TNT 15% & aluminum powder 10%. Although originally invented for industrial use, many explosives of this type have been used for military purposes, such as in Demolition Charges, and as the main filler for Bombs, Grenades, Mortar Shells, and Land & Sea Mines. See also Table 10 under CHEDDITE.

Unusual Research & Development in the Field of Explosives

"Specific Heats of the Organic Constituents of Propulsive Agents and Explosive Mixtures"

An interpretive survey is made of the scanty literature available on the specific heats of simple explosive substances and explosive mixtures. Applications of the Joule-Kopp law of additive atomic heats, where the direct determination of a specific heat is impossible, lead to an interesting table for a number of groups containing C, H, O & N.

[Ref: P. Tavernier, Compte Rendu Congrès International de Chimie Industrielle, 31e Congrès, Liège 1958 (Published as Industrie Chimique Belge, Supplement) 2, 296-302 (1959)(in French) & Chemical Abstracts 54, 8085 (1960)].

"The Thermal Decomposition of Explosives"

The behavior of industrial explosive mixtures containing Nitroglycerin, TNT, Ammonium Nitrate, inert matter, and other constituents was observed under conditions of slow heating, maintaining a constant temperature for a known time. The most effective method was to immerse the explosive in an oil or paraffin bath with a temperature of the order of 200°C. Tables and graphs show the influences of time and temperature on the various mixtures tested and the temperatures at which deflagration occurred.

[Ref: J. Boucart, Compte Rendu Congres International de Chimie Industrielle, 31e Congrès, Liège 1958 (Published as Industrie Chimique Belge, Supplement) 2, 267-70 (1959)(in French) & Chemical Abstracts 54, 8086 (1960)].

Unusual Research & Development in the Field of Explosives (cont'd)

"Measurement of the Shock of Detonation by Means of Mechanical Impulse Devices"

Previously known impulse methods give only a relative value of the brisance effect of the detonation of an explosive charge. It is possible to obtain an exact method with absolute results in terms of the physical system of measurement. Such results are better suited for theoretical evaluation and technical calculations. For these reasons the mechanical impulse measurement methods using the weight and pendulum systems for the measurement of the shock of detonation are brought together. These methods of measurement, their various applications, and the significance of the results are discussed. The dependence between the measured amount of impulse and the properties of the detonating system and of the solidity of the object struck by the shock is also discussed.

[Ref: J.F. Roth, Compte Rendu Congrès International de Chimie Industrielle, 31^e Congrès, Liège 1958 (Published as Industrie Chimique Belge, Supplement) 2, 187-91 (1959) & Chemical Abstracts 54, 6129 (1960)].

"New Test Methods for Explosive Materials"

The known methods for determining the sensitivity of materials capable of explosion have not proved adequate for reliable determination of the dangers which appear in the preparation, manufacture, and use of these materials. Hence, new methods have been developed for determining their sensitivity upon heating in an enclosure, and for determining their sensitivity to friction & impact. The new methods make it possible to obtain independent numerical results of the individual influences, and to increase the number of materials susceptible to being tested.

[Ref: H. Koenen & K.H. Ide, Compte Rendu Congrès International de Chimie Industrielle 31^e Congrès, Liège 1958 (Published as Industrie Chimique Belge, Supplement) 2, 181-86 (1959) (in German) & Chemical Abstracts 54, 6129 (1960)].

Unusual Research & Development in the Field of Explosives (cont'd)

"Influence of Damming of Explosives on the Characteristic Data of the Detonation Zone"

The effect of damming is investigated, by means of a 5-mm.-thick mantle of pressed NaCl, on the detonation of explosives consisting essentially of nitroglycerin, nitroglycol, trinitrotoluene, NH_4NO_3, NaCl, and wood dust. As compared to undammed charges of 26-mm. diameter (in a paper jacket), the detonation rate of the various explosives (2000-3000 m./sec.) is increased by 170-980 m./sec. by the pressed NaCl jacket. Further experiments with tubes 5-mm. thick made of polyethylene as a dam with a charging of 20- and 26-mm. and undammed charges (20-, 26-, 36-mm. diameter) show that the length of the reaction zone is shortened with increasing charge diameter, thus increasing detonation rate. At the same diameter of 26 mm., the length of the reaction zone increases from 3.7 to 4 and 4.6 mm. with increasing detonation rates of 1965, 2170, and 2305 m./sec. (undammed, polyethylene, NaCl). In the case of a thin casing, i.e. below the thickness of the reaction zone of about 3-4 mm., the diameter and inertia are of decisive effect; however, in the case of a thick casing (4 mm.) especially, the compressibility is important. The experimental results for the maxium detonation rate agree well with those calculated according to the formulas of Jones, and of Copp and Ubbelohde, in which, in addition to the diameter of the charge and the detonation rate for a certain diameter, the angle formed by the casing during expansion of the detonation gases and by the charge axis, which can be determinated by x-ray flash pictures, is used. The bend of the detonation front becomes smaller with increasing diameter, and it considerably decreases with the same diameter, if the following progression is used in the casing: undammed, 5-mm. polyethylene, and 5-mm. NaCl. Since in the same progression the reaction time becomes longer, which results in a more complete chemical reaction, the improvements brought about by the stiff mantle, such as an increase in detonation rate, broadening the reaction zone, and lengthening the reaction time, lead to an increase in safety of the explosives with a stiff mantle as against those with a powdered casing.

[Ref: L. Deffet, Explosifs 10, 7-11 (1957) & Chemical Abstracts 55, 991 (1961)].

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Belgian Journal, "Explosifs", Special Number 4 (October-December 1958).

French Explosives

Until WW II, France was one of Europe's leading nations in military developments. Her explosives & artillery weapons were of very high quality. Due to the fact that France ceased fighting in the early part of WW II, there has been comparatively little time for the development of new explosives or ammunition. During the German occupation, 1940-45, all French military installations were controlled by the invaders. The manufacture of explosives & ammunition by the French, as well as research & development, were at a standstill during this period. There is, therefore, little information regarding the use of French explosives during the WW II period.

Beginning in 1945-46, research activities were resumed and the opening of some munitions plants followed. At the same time, the world-famous military journals, Mémorial de l'Artillerie Française & Mémorial des Poudres, resumed publication.

The principal explosives known to be used & studied before and after WW II are listed alphabetically in the following pages.

Acide picrique, Mélinite or Trinitrophénol — PICRIC ACID

See Mélinite.

Amatol — AMATOL

There is some information reported which indicates that Amatols were used in France. Two references in the French literature deal with the analysis of Amatols: P. Miaud, Mémorial des Poudres (Paris) 32, 225-29 & 231-38 (1950).

See also Explosif nitraté & NT (Explosif).

Ammonal — AMMONAL

Some WW II compositions used as military explosives are given in Table 3 under AMMONAL.

See also Explosifs nitraté à l'aluminum under Explosif nitraté.

Ammonite — AMMONITE

A commercial blasting explosive consisting of Ammonium Nitrate 91.5% & Dinitronaphthalene 8.5% (called Grisounaphtalite Roche) or Ammonium Nitrate 95.5% & Trinitronaphthalene 4.5%. The granular mixture is compressed into cartridges similar to those used in Britain. The original explosives invented by Favier consisted of Ammonium Nitrate, mononitronaphthalene, paraffin & resin.

Artifices (Pyrotechnic Compositions) — PYROTECHNICS

See Pyrotechnie.

Astralite — ASTRALITE

Azide de plomb or Azoture de plomb — LEAD AZIDE

The preparation of Lead Azide is given by L. Vennin, E. Burlot & H. Lécorché, "Les Poudres et Explosifs", C. Béranger, Paris (1932),

Azide de plomb or
Azoture de plomb (cont'd)

151-2 & 293-95. Some properties are reported by P. Pascal, "Explosifs, Poudres, Gaz de Combat", Hermann, Paris (1930), 245; J. Pepin Lehalleur, "Traité des Poudres, Explosifs et Artifices", Ballière et Fils, Paris (1935), 150-52 & 367; and A. Le Roux, Mémorial des Poudres (Paris) 32, 207 (1950).

Baratol — BARATOL

A high-explosive mixture consisting of barium nitrate & TNT. The 10/90 barium nitrate/TNT and the 20/80 mixture are used as castable bursting charges.

Brugère Poudre — BRUGÈRE POUDRE

A composition prepared by grinding together, pressing and granulating as in the manufacture of Black Powder, a mixture of Ammonium Picrate 54% and potassium nitrate 46%. This composition is more powerful and gives less smoke than Black Powder. It was used as a propellant for the Chassepot Rifle.

A similar composition, called Abel Powder or Picric Powder, was used as a booster charge in Britain.

Calorite française — PYROTECHNICS

An Incendiary Pyrotechnic composition prepared by grinding together a mixture of powdered aluminum & powdered iron oxide with sodium silicate. This composition is compressed into a block which is ignited by means of a fuse combined with a primer mixture consisting of powdered magnesium & barium peroxide.

Cellamite — DYNAMITE

An explosive mixture studied in 1925 by the Commission des Substances Explosives. It consists of Ammonium Nitrate 86%, Nitroglycerin 12%, Nitrocellulose (of 12%N) 0.5% & cellulose 1.5%. This composition has a positive oxygen balance, CUP (modified Trauzl test) value 83% (Picric Acid = 100%) & velocity of detonation 2980 meters/second. [Ref: L. Médard, Mémorial de l'Artillerie Française (Paris) 22, 596-97 (1948)].

Cheddite or Explosif Street | CHEDDITE

Cheddites are special types of chlorate or perchlorate explosives. The grains of chlorates are coated with liquid (or plastic) materials in order to render the grains less hygroscopic and less sensitive to mechanical action, such as impact or friction. These explosives were invented & patented in France in 1897.

Some Cheddites used by several countries prior to WWII and some newer type Cheddite explosives are given in Tables 9 & 10 under CHEDDITE.

Collodion or Pyroxyline | NITROCELLULOSE

A military grade Nitrocellulose, called, in USA, Collodion Cotton, containing 11 to 12% Nitrogen.

Composition d'amorçage (Priming or Initiating Composition) | See Explosif d'armorçage & Fulminate de mercure

Cordeau détonant (Detonating Cord) | PRIMACORD

The Cordeau used for many years and standard in the French Army consisted of a tin tube filled with Picric Acid. Its velocity of detonation was 6900 meters/second. Commercial Cordeau, invented by Lheure, consisted of a lead tube filled with TNT. Its velocity of detonation was 5100 meters/second. Later Tetryl was also used. A Nitromannite Cordeau, proposed by Sébert & Fritsch to the Poudrerie à Sévran-Livry, was considered too expensive & too sensitive to impact.

More recently the Société Anonyme d'Explosifs et de Produits Chimiques has begun to manufacture a Cordeau consisting of flat lead bands filled with Tetryl. It is claimed that flat Cordeau is easier to introduce into a bore hole than round Cordeau.

The velocities of detonation of various Cordeaux, recently determined in France, are reported [by M. Dutour, Mémorial de l'Artillerie Française (Paris) 24, 577-84 (1950)] as follows:

Cordeau détonant (Detonating Cord) (Cont'd)

Cordeau	Core	Cover	Origin	Exterior Diameter mm	Gm Expl/ meter	Velocity of Detonation meter /sec.
Model 1902	Picric Acid	Tin	France	5.4	17	6690-6745
Mining (Harlé)	TNT	Lead	"	5.9	21	5055-5165
Cortex	PETN	Fabric	"	4.8	8	5990-6410
Éclair	PETN	Fabric	"	5.5	11	6355-6745
Primacord	PETN	Fabric	USA	5.2	10	6290-6450
Cordtex	PETN	Fabric	Britain	5.0	10	6715-6825

Coton-poudre (CP) NITROCELLULOSE

A military grade Nitrocellulose consisting of two kinds: Coton-poudre No. 1 or CP_1 (having 13% Nitrogen content) & Coton-poudre No.2 or CP_2 (having 12% Nitrogen content). The designation CP_3 sometimes found in French literature means Nitrocellulose having a Nitrogen content about 11.5%.

A mixture of CP_1 & CP_2, colloided with ether-alcohol, is used to make Poudre B (smokeless propellant). Either CP_1 or CP_2 with Nitroglycerin is used to make Balistite (double-base propellant). Both CP_1 & CP_2 with Nitroglycerin and non-volatile solvents are used to make Balistite atténuée (Attenuated Ballistite).

The mixture of CP_1 & CP_2 is equivalent to US Pyrocotton or Pyrocellulose. Coton-poudre No. 1 nitrated to a higher than 13% Nitrogen content is equivalent to Guncotton.

Crésylite CRÉSYLITE

A French designation for Trinitro-meta-cresol and also for its mixtures with Picric Acid. The mixture of Trinitrocresol 60% & Picric Acid 40% is called Crésylite No. 2. It becomes plastic at 65-70°C and melts at 85°C. On being remelted, it first assumes a pasty consistency, after which (in about 6 hours) it solidifies to an extremely compact substance.

It has been used as an HE bursting charge cast loaded into some Projectiles. This mixture was adopted in Italy under the name Cresilite.

CSE (Explosif) CSE (EXPLOSIF)

Several high-explosive compositions were developed after WW II by CSE (Commission des Substances Explosives). They are reported by L. Médard, Mémorial des Poudres (Paris) 32, 211, 215 & 222 (1950):

55-CSE-1948. Consists of Ammonium Chlorate 74%, Dinitrotoluene 23% & cork flour 3%. Its CUP (Coefficient d'utilisation pratique; a French modified Trauzl test) value is 93% (Picric Acid = 100%).

58-CSE-1948. Consists of Sodium Chlorate 74%, Dinitrotoluene 23% & sawdust 3%. Its CUP value is 89%.

Both of these explosives belong to the "Explosifs du type OC" (Chlorate Explosives also known as Cheddites or Streetites). They are used in mining & blasting operations.

63-CSE-1949. Consists of Ammonium Nitrate 67%, 20/80 Pentolite 12% & aluminum powder 21%. Its CUP value is 147%.

This explosive belongs to the "Explosifs du type N" (Nitrate Explosives).

68-CSE-1949. Consists of Ammonium Nitrate 20%, PETN 20%, Dinitronaphthalene 1.5% & sodium chloride 58.5%. Its CUP value is 43%.

123-CSE-1948. Consists of Ammonium Nitrate 17%, PETN 23% & sodium chloride 60%. Its CUP value is 43%.

133-CSE-1948. Consists of Ammonium Nitrate 22%, PETN 20%, TNT 3% & sodium chloride 55%. Its CUP value is 46%.

The last three explosives also belong to the "Explosifs du type N". They are safe to use in any fiery coal mine. The 123-CSE-1948 was authorized for use in 1950 under the official name "Explosif du type N n° 63", and the 133-CSE-1948 as "Explosif du type N n° 64".

See also Explosif nitraté & Explosif platique.

Cyclotetraméthylènetetranitramine or Octogène HMX

See under "Unusual Research & Development in Explosives" (French Explosives).

Cyclotriméthylènetrinitramine — RDX

Hexogène

See Hexogène.

Cyclotriméthylènetrinitrosamine — R-SALT

This compound was prepared and investigated as an explosive in France as early as 1934, by Professor M. Delépine of the Poudreeie du Bouchet. The compound was assumed to be unstable, but a sample prepared by Delépine and left in storage was found four years later to be well preserved. Work on this compound was then resumed at the Laboratoire Central des Poudres,& at the Centre d'Études du Bouchet but was interrupted by WW II.

The results of these studies with respect to preparation, properties, stabilization & semi-industrial manufacture of R-Salt are reported by P. Aubertein, Mémorial des Poudres (Paris) 33, 227-39 (1951) [Laboratory preparation of cyclotriméthylènetrinitrosamine (R-Salt) & determination of some of its properties; and H. Ficheroulle & A. Kovache, Mémorial des Poudres (Paris) 33, 241-53 (1951) (Semi-plant scale preparation & stabilization of R-Salt)].

DD (Explosif) — DD (EXPLOSIF)

This name is applied to a series of explosive mixtures consisting of Picric Acid & Dinitrophenol in various proportions, such as 60/40, 63/37, 71/29 & 75/25. The first of these compositions known as DD 60/40, Mélange DN 60/40 or MDn (Explosif) melts at 85°C. It was used to a great extent prior to WW II as a castable bursting charge for various Projectiles. The 60/40 mixture corresponds to the British Shellite & Italian MBT and the 71/29 mixture is similar to US Tridite.

These mixtures can be prepared either by fusing Dinitrophenol with Picric Acid, or by direct nitration of phenol previously dissolved in carbon tetrachloride, in order to obtain the desired proportions of Dinitrophenol & Trinitrophenol (Picric Acid) in the composition.

See also MDPC (Explosif).

Détonateur électrique — ELECTRIC DETONATOR

The Electric Detonators described prior to WW II are reported to contain an Igniter Powder (fuse head powder) for Spark Detonators (Amorces à l'étincelle) consisting of antimony trisulfide 44%, Potassium

Détonateur électrique (cont'd):

Chlorate 44% & graphite 12%. This mixture is electroconductive. The composition of Bridge-Wire Detonators (Amorces à incandescence du fil) is non-conductive and consists of a dry Nitrocellulose powder, or a mixture of Potassium Chlorate 56%, cuprous sulfide 15% & cuprous phosphide 29%.

Dinitrate de dioxyéthyldinitro-oxamide [Dinitro-di (β-nitroxyethyl)-oxamide] — DINITRATE DE DIOXYÉTHYLDINITROOXAMIDE

This HE compound is known by its code name NENO, from Nitrated Ethyl Nitro Oxamide. It is more correctly called N, N'-Dinitro-N, N'- bis (2-nitrooxyethyl)-oxamide $[O_2NOCH_2CH_2N(NO_2)CO]_2$. It was prepared in France by G. Desseigne [Mémorial des Poudres 30, 101-10 (1948)] who also determined its properties: Melting point 95°C (crystals from acetone); soluble in acetone & ethyl acetate; slightly soluble in benzene; practically insoluble in chloroform, ethyl alcohol & carbon tetrachloride. The material before recrystallation had an Abel Heat test value at 80°C of 45-50 seconds; the recrystallized material gave a test value of 6 minutes, 13 seconds.

NENO has been studied in binary mixtures with TNT in Canada [See: A.N. Campbell & H.A. Kushnarov, Canadian Journal of Research 25B, 216-27 (1947)].

Dinitroxydiéthylnitramine (Diethanolnitramine Dinitrate) — DINITROXYDIÉTHYLNITRAMINE

This compound, also called DINA in USA, $(O_2NOCH_2CH_2)_2N.NO_2$, was prepared & examined in France after WW II by G. Desseigne [Mémorial des Poudres 32, 117-20 (1950)]. It is obtained in 90% yield by nitration of diethanolamine with 97% nitric acid in the presence of acetic anhydride & a small amount of a Cl^- ion serving as a catalyst. The product gives a value of 13 minutes in the Abel Heat test at 60°C; its power & velocity of detonation are higher than similar values for Nitroglycerin; and it is much less sensitive to initiation by shock than Nitroglycerin.

DINA is a good gelatinizer for Nitrocellulose. It is recommended as a replacement for Nitroglycerin in explosive mixtures containing Nitroglycerin.

Dynamite

DYNAMITE

French Dynamites are divided into three classes:
I. Dynamites à base inerte (Dynamites with inert base). To this class belongs Dynamite guhr consisting of Nitroglycerin 75% & kieselguhr 25%. This type of Dynamite is much more sensitive to initiation than Dynamite gomme (Blasting Gelatin). It was used as a booster charge in some blasting & demolition operations so that failures in functioning would not occur. It was also used as a means of safely transporting Nitroglycerin which could be recovered by heating the guhr sticks with hot water.

II. Dynamites à base active (Dynamites with active base)

a) Dynamite gomme (Blasting Gelatin). The usual composition is Nitroglycerin 92-3% & Collodion Cotton (Nitrogen content 11.2%) 8-7%. It is also called Gomme A and corresponds to the German Sprenggelatine. See also Gomme.

b) Dynamite gélatine (Gelatin Dynamite). A typical composition consists of Nitroglycerin 57%, Collodion Cotton 3%, potassium or sodium nitrate 34%, sawdust 4%, cereal flour 1.8% & ochre (colorant) 0.2%.

It seems that in France there is no sharp distinction between "Gomme" & "Gélatine" as shown by the following examples, from the same source, called "Dynamite gélatine":

1) Dynamite gomme extra forte - Nitroglycerin 92-3% & Collodion Cotton 8-7% (This is the same composition as Dynamite gomme above).

2) Dynamite gomme potasse - Nitroglycerin 82-3%, Collodion Cotton 6-5%, potassium nitrate 9-10% & woodmeal 2-3%.

3) Dynamite gomme soude - Nitroglycerin 82-3%, Collodion Cotton 6-5%, sodium nitrate 9-10% & woodmeal 2-3%.

4) Gélatine A - Nitroglycerin 64%, Collodion Cotton 3%, sodium nitrate 24%, woodmeal 8% & magnesium carbonate 1%.

5) Gélatine B potasse - Nitroglycerin 57.5%, Collodion Cotton 2.5%, potassium nitrate 32% & woodmeal 8%.

6) Gélatine B soude - Nitroglycerin 57%, Collodion Cotton 3%, sodium nitrate 34% & woodmeal 6%.

7) Gélignite - Nitroglycerin 58%, Collodion Cotton 2%, potassium nitrate 28%, woodmeal 9% & flour 3%. See also under Dynamites atténuées below.

Dynamite (cont'd)

c) Dynamite gomme incongélable (Non-freezing Gelatin Dynamite). Among these compositions may be mentioned those of:

1) la Société Nobel Française - Nitroglycerin 75%, Collodion Cotton 15% & Dinitrotoluene 10%.

2) la Société d'Explosifs et des Produits Chimiques - Nitroglycerin 66.4%, Nitroglycol 16.6%, Collodion Cotton 5%, potassium or sodium nitrate 10% & sawdust 2%.

d) Dynamite pulvérulente (Pulverulent Dynamite) The following are among some compositions reported:

1) Dynamite de Cugny No 1 - Nitroglycerin 40%, Ammonium Nitrate 45%, sodium nitrate 5% & wood cellulose 10%.

2) Dynamite de Cugny No 2 - Nitroglycerin 20%, Ammonium Nitrate 75% & wood cellulose 5%.

3) Dynamite de Cugny No 3 - Nitroglycerin 22%, Ammonium Nitrate 75% & charcoal 3%,

4) La Nobélite de la Societé Nobel Française - Nitroglycerin 20%, Collodion Cotton 1.6%, sodium nitrate 60%, Dinitrotoluene 14%, sawdust 4.3% & sodium bicarbonate 0.1%.

III. Dynamites attenuées (Attenuated Dynamites). Examples of this class of Dynamite are:

Gélignite - Nitroglycerin 62.5%, Nitrocellulose 2.5%, sodium nitrate 26.25%, wood flour 8.4% & sodium carbonate 0.35% and

Grisoutine or Grisoutite (Safety or Permissible Dynamite). See Explosif antigrisouteux.

See also Explosif de mine.

Dynamite gélatine — GELATIN DYNAMITE

See under Dynamite.

Dynamite gomme — BLASTING GELATIN

See under Dynamite.

Dynamite O — DYNAMITE

See under Explosifs antigrisouteux.

Dynamite pulvérulente (Powdery Dynamite) — DYNAMITE

See under Dynamite.

Echos or Escho (Explosif) — ECHOS

A military explosive consisting of Ammonium Nitrate 75-80%, aluminum powder 2-3%, ferrosilicon 14-16% & "ipposino" (dried, pulverized horse dung) 5-7%. This is the same composition as used by the Italians under the same name.

Éthylènedinitramine — EDNA

This compound called Ethylenedinitramine (abbreviated EDNA) or N,N'-Dinitroethylenediamine was prepared & its properties described in the French literature by H. Ficheroulle, Mémorial des Poudres (Paris) 30, 89-100 (1948).

Explosif antigrisouteux (Permissible Explosive) — AMMONIUM NITRATE DYNAMITE

To this group of Dynamites belong "Explosifs de Favier", "Grisou dynamites" & "Grisoutines". These are blasting explosives permitted for use in coal mines. Some specific compositions manufactured in 1935 by Poudrerie de l'État (Government Powder Factory) and supplied to industry in cartridges include:

Grisounaphtalite couche (Ammonium Nitrate 95% & Trinitronaphthalene 5%)

Grisounaphtalite roche (See under Ammonite)

Grisounaphtalite salpêtrée (Ammonium Nitrate 90%, potassium nitrate 5% & Trinitronaphthalene 5%)

Grisounaphtalite roche salpêtrée (Ammonium Nitrate 86.5%, potassium nitrate 5% & Dinitronaphthalene 8.5%)

Poudre Favier pour mines nongrisouteuses (Ammonium Nitrate 87.5% & Dinitronaphthalene 12.5%)

Explosif antigrisouteux (cont'd):

Grisoutétrylite couche (Ammonium Nitrate 88%, potassium nitrate 5% & Tetryl 7%).

Poudre de mine C 1b (Ammonium Nitrate 78% & Ammonium Trinitrocresylate 22%).

Some current Explosifs antigrisouteux compositions include:

N n°7 (Ammonium Nitrate 76%, Dinitronaphthalene 7%, wood flour 2% & sodium chloride 15%).

N n°9 (Ammonium Nitrate 48.2%, TNT 9.5%, wood flour 1.65% & sodium chloride 41%).

N n°32 (Ammonium Nitrate 78%, Dinitrodichlorobenzene 12% & aluminum powder 10%).

N n°62 (Ammonium Nitrate 12%, PETN 23% & sodium chloride 65%).

Some Ammonium Nitrate Dynamites suitable for general blasting operations include:

Dynamite O (See Table 6 under AMMONIUM NITRATE).

Forcite extra (See Table 6 under AMMONIUM NITRATE).

Grisoudynamite roche (See Table 6 under AMMONIUM NITRATE).

Grisoudynamite couche (Ammonium Nitrate 87.5%, Nitroglycerin 12% & Collodion Cotton 0.5%).

See also Dynamite & Explosif nitraté.

Explosif d'amorçage — PRIMING AND INITIATING COMPOSITION

Priming & Initiating Compositions used in France prior to WW II are described by P. Pascal , "Explosifs, Poudres, Gaz de Combat", Hermann, Paris (1930), page 239; by L. Vennin, E. Burlot & H. Lécorché, "Les Poudres et Explosifs", C. Béranger, Paris (1932), pages 567-72; and by J. Pepin Lehalleur, "Traité des Poudres, Explosifs et Artifices", Ballière et Files, Paris (1935), page 365.

Compounds prepared & studied since WW II and proposed as Priming & Initiating compounds by H. Ficheroulle & A. Kovache, Mémorial des

Explosif d'amorçage (cont'd)

Poudres 31, 7-27 (1942) & Chemical Abstracts 46, 11686 (1952)], include:

Trinitrorésorcinate de plomb (Lead Styphnate)

Trinitrométaoxybenzoate de plomb (Lead Trinitro-m-hydroxybenzoate)

Trinitrophloroglucinate de plomb (Lead Trinitrophloroglucinol)

Tétrazène (Tetracene)

Nitrate de diaminotétrazène (Diaminotetrazene Nitrate or 3, 6-Diamino-3, 6-dihydro-s-tetrazene Dinitrate)

Trinitrotriazidobenzène (2,4,6-Trinitro-1,3-5-triazidobenzene)

Hexaméthylènetriperoxydiamine (Hexamethylenetriperoxydiamine)

Diazodinitrophénol (Diazodinitrophenol)

Tricyclo acétone peroxyde (Tricycloacetone Peroxide)

Only Lead Styphnate & Tetracene were considered useful as Explosive Primers. This conclusion is based on the determination of a number of properties of the above compounds.

See also Fulminate de mercure.

Explosif DD — DD (EXPLOSIF)

See DD (Explosif).

Explosif de Favier — AMMONIUM NITRATE DYNAMITE

See under Ammonite and under Explosif antigrisouteux.

Explosif de mine (Mining Explosives) — DYNAMITE

Some mining explosives have been prepared from surplus or discarded propellant powders. One such composition consisted of "Poudre B" 30-50% & Ammonium Nitrate 70-50%. This mixture is prepared by pulverizing Poudre B, under water, removing the bulk of water and

Explosif de mine (cont'd)

mixing the moist propellant with powdered Ammonium Nitrate at a temperature below 100° C. The composition is dried by spreading the hot paste on a cold surface, pulverizing the solified material, and drying at 60-70° C.

The properties of 40/60 Poudre B/Ammonium Nitrate mixture are as follows: Density 1.65 gm/cc (compressed to maximum density), bulk density 0.60 gm/cc, CUP value 122% (Picric Acid = 100%), and velocity of detonation 4500 meters/second.

Recent progress & trends in French Mining Explosives are described by L. Médard, Mémorial des Poudres 32, 209-24 (1950). Some types developed & manufactured after WW II include: Explosifs antigrisouteux, Explosifs nitratés à la pentolite, Explosifs nitratés à l'aluminium, Explosifs nitratés résistant a l'eau, Explosifs plastiques, Grisou dynamites, Nobélite, Sevranite, Sofranex A, Tolamite & others.

See also under Dynamite.

Explosif de sûreté (Safety Explosive) — EXPLOSIF ANTIGRISOUTEUX

See Explosif Antigrisouteux.

Explosif du type N (Nitrate Explosive) — AMMONIUM NITRATE EXPLOSIVES & CSE (EXPLOSIF)

Explosif du type OC (Chlorate Explosive) — CSE (EXPLOSIF)

See CSE (Explosif).

Explosif MDN or MDn — MDN (EXPLOSIF)

See MDN (Explosif).

Explosif MDPC — MDPC (EXPLOSIF)

See MDPC (Explosif).

Explosif MMn — MMn (EXPLOSIF)

See MMn (Explosif).

Explosif nitraté (Nitrate Explosive) or Explosif du Type N

AMMONIUM NITRATE EXPLOSIVES

Before 1940 there were manufactured in France the following explosives:

N n° 0 (Amatol) - Ammonium Nitrate 78.7% & TNT 21.3%. Its CUP value is 120%.

N n° 1b - Ammonium Nitrate 91.5% & Dinitronaphthalene 8.5%. Its CUP value is 103%.

N n° 1c - Ammonium Nitrate 87.4% & Dinitronaphthalene 12.6%. Its CUP value is 111%.

All of these compositions met the requirements of the so-called "Explosifs de sûreté (Safety Explosives). After WW II compositions N n° 1b & N no 1c were replaced by:

N n° 1d - Ammonium Nitrate 89%, Dinitronaphthalene 9% & wood flour 2%.

I. Explosifs nitratés à l'aluminium (Nitrate Explosives with aluminum)

These blasting explosives were developed in France beginning in 1935 and later after WW II. Some current compositions are:

N n° 30 (Ammonal) - Ammonium Nitrate 80.2%, TNT 10.6% & aluminum 9.2%. Its CUP value is 132%.

N n° 31 - Ammonium Nitrate 78.5%, Pentolite (20/80) 12.3% & aluminum 9.2%. Its CUP value is 138%.

N n° 32 - See under Explosifs antigrisouteux.

N n° 33 (Ammonal) - Ammonium Nitrate 69%, TNT 10% & aluminum 21%. Its CUP value is 146%.

63-CSE-1949 See under CSE (Explosifs).

II. Explosifs nitratés à la pentolite (Nitrate Explosives with Pentolite)

These explosives were developed during WW II and manufactured after WW II.

N n° 20 - Ammonium Nitrate 78.2%, Pentolite (20/80) 18.8% & wood flour 3.0%. Its CUP value is 120%.

Explosif nitraté (cont'd):

N n° 21 - Ammonium Nitrate 75.4% & Pentolite (20/80) 24.6%. Its CUP value is 124%.

N n° 31 - See above under Explosifs nitratés à l'aluminium.

63-CSE-1949 - See under CSE (Explosif).

III. Explosifs nitratés resistant à l'eau (Nitrate Explosives Resistant to Water)

In order to render Ammonium Nitrate explosives resistant to water, L. Médard [Mémorial des Poudres 32, 216-17 (1950)] proposed to incorporate 0.5-1% of calcium stearate into the mixture. The Commission des Substances Explosives (CSE) studied not only the use of the stearates, but also of abietates, naphthenates, resinates & alginates. It was concluded that calcium stearate is the most efficient water-proofing agent studied. It should be noted that calcium stearate also decreases the sensitivity of these explosives to shock, friction & initiation.

For those explosives containing aluminum, the incorporation of a small amount of calcium stearate proved to be ineffective.

See L. Le Roux, Mémorial des poudres 33, 265-82 (1951), for a list of compositions studied.

See also CSE (Explosif).

Explosif NTMX — NTMX (EXPLOSIF)

See NTMX (Explosif).

Explosif NX — NX (EXPLOSIF)

See NX (Explosif).

Explosif P — CHEDDITE

This is a mining explosive consisting of Potassium Chlorate 90% & paraffin 10%. At a density of 1.45 gm/cc, its velocity of detonation is 3565 meters/second.

This name is also applied to an explosive consisting of Ammonium Perchlorate 61.5%, sodium nitrate 30.0% & paraffin 8.5%.

Explosif P (cont'd)

It is reported that these explosives undergo considerable deterioration during prolonged storage in a humid atmosphere, resulting in loss of explosive power.

See also Cheddites above and Esplosivo P under Italian Explosives.

Explosif perchloraté (Perchlorate Explosive) CHEDDITE

Perchlorate as well as Chlorate Explosives, desensitized with paraffin, were used as bursting charges in some Bombs & Hand Grenades.

Examples of some other mixtures are:

No. 1 - Ammonium Perchlorate 82%, Dinitrotoluene 13% & castor oil 5%.

No. 2 - Ammonium Perchlorate 50%, potassium nitrate 30%, Dinitrotoluene 15% & castor oil 5%.

A mixture of Ammonium Perchlorate 86% & paraffin 14% was used prior to WW II, and in the development of the above compositions.

See also Cheddite.

Explosif plastique PLASTIC EXPLOSIVE

Since WW II a number of plastic explosives have been developed and/or patented in France. Some examples of these are as follows:

L. Médard et État Français, French Patent 947052 (1949) [Mémorial des Poudres 31, 443 (1949) & Chemical Abstracts 45, 3599 (1951)]. A plastic explosive containing no Nitroglycerin is prepared by mixing PETN (or RDX) 45%, Sodium Chlorate 31% & a plasticizer (prepared by dissolving 0.5-1 kg of polyvinyl acetate of a low degree of polymerization in 1 liter of liquid DNT) 24%. This composition is fairly water resistant and suitable for use in mines. The inventors claim that no noxious gases such as hydrogen chloride are produced when Ammonium Perchlorate is used as the oxidizer and some powdered aluminum (about 8% of the amount of Ammonium Perchlorate) is incorporated in the composition.

Explosif plastique (cont'd)

"Sevranite n° 1" of L. Médard et État Français, French Patent 947053 (1949) [Mémorial des Poudres 31, 445 (1949) & 32, 219 (1950)]. A plastic explosive containing no Nitroglycerin is prepared by mixing PETN (or RDX) 48%, Ammonium Perchlorate 31%, powdered aluminum 3%, and a plasticizer (prepared by dissolving 1 part of polyvinyl chloride in 17 parts of liquid Dinitrotoluene) 18%. This composition at a pressed density of 1.70 gm/cc has a velocity of detonation of 7000 meters/second. It can be kept under water for several weeks without any effect on explosive power. Its CUP value is 142% (Picric Acid = 100%).

Explosifs du type OC (Chlorate Explosives). A number of these explosives used prior to WW II are described by L. Médard [Mémorial des Poudres 32, 210-12 & 218 (1950)]. One later composition, OC n° 18, consists of Sodium Chlorate 74%, liquid DNT 19%, Nitroglycerin 5.5% & Collodion Cotton 1.5%. This composition may be considered as "Gélatine Cheddite" and appears to be a modification of an explosive used in Switzerland. See also under CSE (Explosif).

Explosif plastique PE 1. Consists of RDX/mineral jelly/liquid paraffin/rubber. This composition is similar to US Composition C-4.

Explosif plastique PE 3A. Consists of RDX/Shell Mex oil/liquid paraffin/ lecithin/carbon black.

Explosif plastique à la penthrite. Consists of PETN/mineral oil.

Explosif plastique TG. Consists of RDX 78.5%, Collodion Cotton 17.5% & agglomerant 4%.

Explosif plastique TN. Consists of RDX 88%, plasticizer 11.9% & lampblack 0.1%.

The specific uses of French Plastic Explosives in ammunition is not reported.

Other Plastic Explosives are called Nobélite, Sevranite, Sofranex A & Tolamite.

Explosif (ou Poudre) de l'État Francais (Explosive or Propellant of the French Government) — EXPLOSIF (ou POUDRE)

Explosive mixtures, having a high temperature of deflagration, consist of Ammonium Perchlorate or the Nitrate, Chlorate or Perchlorate of Sodium or Potassium, and supporters of combustion such as Nitroguanidine, Hexanitrodiphenylamine, or 9-Oxo-2,4,5,7-tetranitrodiphenylamine.

Explosif-Poudre (cont'd)

It is claimed that these mixtures are suitable for use as Propellants in weapons operating at high temperatures, or as explosives for oil-sounding at great depth underwater. [Ref: État Français, French Patent 971644 (1951) & Chemical Abstracts 46, 9311 (1952)].

Explosif S — SCHNEIDERITE

See Schneiderite.

Explosif Street or Cheddite — CHEDDITE

See Cheddite.

Forcite extra — AMMONIUM NITRATE DYNAMITE

See under Explosif antigrisouteux.

Formule 226 — FORMULE 226

An aluminized explosive, tested before WW II by the Commission des Substances Explosives (CSE), consisting of Ammonium Nitrate 74.5%, Nitroglycerin 12%, Dinitronaphthalene 6%, cellulose 2%, Nitrocellulose (12% Nitrogen) 0.5% & aluminum 5%. This composition has a CUP value of 130% and velocity of detonation of 3400 meters/second.

Fortex — FORTEX

A military bursting charge consisting of Ammonium Nitrate 70% & Tetryl 30%. A composition called "Fortex antigrisouteux" (safety Fortex) consisted of Ammonium Nitrate 78.5% & Tetryl 21.5%.

These explosives were manufactured during WW I by the Société Anonyme d'Explosifs et de Produits Chimiques.

Fulmicoton — GUNCOTTON

One of the names for Guncotton. See also Pyroxyle.

Fulminate de mercure — MERCURY FULMINATE

Mercury Fulminate is manufactured in France from the usual starting materials, mercury, concentrated nitric acid & ethyl alcohol, by the method of Chandelon which is a modification of the method of Liebig.

It is used alone in commercial detonators, and in some "Compositions d'amorcage" (Priming & Initiating Compositions) such as:

1) Mercury Fulminate 80% & Potassium Chlorate 20%.

2) Mercury Fulminate 13.7%, Potassium Chlorate 41.5%, antimony trisulfide 33.4%, powdered glass 10.7% & glue 0.7%.

3) Mercury Fulminate 37.5%, Potassium Chlorate 5.4% & Tetryl 57.1%.

4) Mercury Fulminate 27.25%, Potassium Chlorate 27.25% & antimony trisulfide 45.50% (Primers for Rifle Cartridges).

5) Mercury Fulminate 50%, Potassium Chlorate 25% & antimony sulfide 25% (Primers for Cannon Cartridges).

The trend is to gradually replace Mercury Fulminate as an initiating agent with Lead Azide (Azide de plomb or Azoture de plomb)

Gélatine — GELATIN DYNAMITE

See under Dynamite.

Gélignite — GELATIN DYNAMITE

See under Dynamite.

Gomme — GELATIN DYNAMITE

See under Dynamite.

Grisoudynamite — DYNAMITE

See under Explosif antigrisouteux.

Grisounaphtalite — DYNAMITE

See under Explosif antigrisouteux.

Grisoutétrylite — DYNAMITE

See under Explosif antigrisouteux.

Hexamine, Hexanitrodiphénylamine or Hexyl — HEXANITRODIPHÉNYLAMINE

This high-explosive compound, also called Dipicrylamine, has a velocity of detonation of 7000 meters/second at a density of 1.60 gm/cc. Because of its high melting point (ca 240°C), Hexyl is usually mixed with other explosives such as TNT or Dipicrylsulfide (Hexanitrodiphenylsulfide).

There is no information to indicate that Hexyl or its admixtures were used in ammunition. Such mixtures are known to have been used in Germany as a bursting charge for Aerial Bombs.

A. Le Roux [Mémorial des Poudres (Paris) 32, 200 (1950)] examined this compound from the point of view of its resistance to heat in order to determine its suitability for use in blasting operations in the search for petroleum. Heating of Hexyl at 140, 160 & 180°C for three hours did not cause any decomposition; all samples were detonated without any difficulty by using detonators containing Mercury Fulminate, or its equivalent.

Hexogène, T4 or Cyclotriméthylènetrinitramine — RDX

Information is not available as to the commercial manufacture of RDX in France before WW II. However, the laboratory preparation and the knowledge of its explosive properties were known at least as early as 1931. Several references to such studies appear in the French literature.

The study of RDX in France was interrupted by the German occupation of France in 1940. These studies were resumed after WW II as indicated by the appearance of post-WW II publications in France. For example, A. Le Roux [Mémorial des Poudres (Paris) 32, 199-200 (1950)], in order to ascertain whether some mixtures of RDX with other substances would withstand the temperatures encountered in blasting operations in the search for petroleum, prepared and studied the following mixtures:

1) 99.5/0.5% RDX/graphite

2) 95/5% RDX/paraffin

3) 95/5% RDX/mononitronaphthalene

These mixtures were heated at 140,160 & 180°C for three hours. The first mixture did not decompose at all; the second mixture gave no evidence of

Hexogène, T4 or Cyclotriméthylènetrinitramine (cont'd)

decomposition, except the paraffin melted which caused occasional failures in detonation; and the third mixture suffered appreciable decomposition at 180°C.

See also F. Tabouis, M. Ortigues & P. Aubertin, Mémorial des Poudres (Paris) 33, 59-93 (1951), for additional studies involving RDX.

A. Le Roux [Mémorial des Poudres (Paris) 33, 95-111 (1951)] continued the study of phlegmatized RDX and developed in 1949, at the Laboratoire de la Commission des Substances Explosives, the following mixture: RDX 80%, aluminum powder 15% & mononitronaphthalene 5%. It has a bulk density of 1.05 gm/cc and a compressed density of 1.70 gm/cc at a pressure of 2100 kgm /sq cm. Its CUP (coefficient d'utilisation pratique or modified Trauzl test) value is 156% (Picric Acid = 100%), sensitivity to shock with a 2 kg weight 200 cm (44% explosions); and velocity of detonation 7990 meters/second.

See also Explosif plastique.

Hexogène/cire d'abeille (RDX/Beeswax) — COMPOSITION A

A pressed explosive composition consisting of RDX/beeswax/0.5-2% graphite. Paraffin wax may be substituted for beeswax. This explosive is similar to US Composition A.

Hexolite or HT (Hexogène-Tolite) — COMPOSITION B

A castable explosive composition consisting of RDX 59.5%, TNT 39.5% & beeswax 1%. This explosive is similar to US Composition B.

HEXYL — HEXANITRODIPHENYLAMINE

See Hexamine.

HT or Hexolite — COMPOSITION B

See Hexolite.

Kaïpinite | CHEDDITE; KAÏPINITE

These compositions, resembling Cheddites, were developed in France based on the study of Belgian Yonckites. Their compositions are as follows:

Kaïpinite O n° 12 - Ammonium Perchlorate 38%, sodium nitrate 28% & TNT 34%.

Kaïpinite O n° 13 - Ammonium Perchlorate 41%, sodium nitrate 31% & Trinitronaphthalene 28%.

These mixtures are used for demolition & mining purposes.

MDN or MDn (Explosif) (Mélinite-Dinitro-naphtaline) | MDN (EXPLOSIF)

A castable explosive mixture consisting of Picric Acid 80% & Dinitronaphthalene 20%. This composition melts near 105°C. It is used as the bursting charge for various Projectiles & Bombs.

MDPC (Explosif) (Mélinite-Dinitro-phenol-Crésylite) | MDPC (EXPLOSIF)

A castable explosive mixture consisting of Picric Acid 55%, Dinitrophenol 35% & Trinitro-meta-cresol 10%. This mixture melts below 100°C. It is used as a burster charge in some Projectiles.

See also DD (Explosif).

Mélange Massenet (Massenet Mixture) | INCENDIARY

An Incendiary Pyrotechnic mixture intended to ignite on contact with water is prepared by fusing naphthalene with metallic sodium and then cooling the mixture while agitating it rapidly. The resulting cast consists of small globules of sodium dispersed in the mass of solid naphthalene. Up to 50% of sodium may be incorporated in this manner, and as little as 7% of sodium is capable of inflaming the mixture when it is brought in contact with water.

Mélange NPMn | BOOSTER

See Relais (Explosif pour).

Mélinite, Acide picrique or Trinitrophénol | PICRIC ACID

Picric Acid was prepared in France before WW II by treatment of phenol with sulfuric acid, followed by mixed nitric-sulfuric acid.

Straight Picric Acid has been used in Cordeau détonant and for loading some Projectiles, Bombs, Boosters, Detonators, Mines & Demolition Charges. Despite its high melting point (122°C) and the danger of casting at high temperatures, many Projectiles were cast loaded. It was considered safer, however, to lower its melting point by incorporating other substances such as nitronaphthalene, Dinitrophenol & paraffin. Such mixtures are known as DD (Explosif), MDN (Explosif), MDPC (Explosif), MMn (Explosif), MTTC (Explosif) & MTX (Explosif).

The name Mélinite has also been used in France not only to designate pure Picric Acid, but also some of its mixtures.

The name Mélinite P is applied to a mixture of Picric Acid 88% & paraffin 12%. This explosive, melting at 80°C. is used for cast loading some Projectiles.

See also Crésylite, Poudre verte & Relais (Explosif).

MMn (Explosif) (Mélinite-Mononitronitronaphtaline) | MMn (EXPLOSIF)

This explosive mixture consists of Picric Acid 70% & mononitronaphthalene 30%. It melts at 80°C. It is used as a castable bursting charge in some Projectiles of hardened steel, and in Bombs of the antipersonnel & general-purpose types.

MTTC (Explosif) (Mélinite-Tolite-Trinitrocrésol) | MTTC (EXPLOSIF)

This explosive mixture consists of Picric Acid 55%, TNT 35% & Trinitrometa-cresol 10%. It melts below 100°C and is used as a castable bursting charge in some Projectiles.

MTX (Explosif) (Mélinite-Tolite-Xylite) | MTX (EXPLOSIF)

This explosive mixture consists of Picric acid 55%, TNT 35% & Trinitro-meta-xylene 10%; or of Picric Acid 30%, TNT 25% & Trinitro-meta-xylene 45%. It melts at 80°C and is used as a castable bursting charge in some Projectiles.

N (Explosif) — CSE (EXPLOSIF)

See also Explosif nitraté.

N n° 0, 1b, 1c & 1d — AMMONIUM NITRATE EXPLOSIVES

See Explosif nitraté.

N n° 7, 9, 32 & 62 — AMMONIUM NITRATE DYNAMITE

See Explosif antigrisouteux.

N n° 20, 21, 30, 31 & 33 — AMMONIUM NITRATE EXPLOSIVES

See Explosif nitraté.

Nitrate d'ammoniaque — AMMONIUM NITRATE

Ammonium Nitrate is used extensively in France in commercial explosives and in composite military explosives.

See Amatol, Ammonal, Ammonite, Cellamite, CSE (Explosif), Dynamite, Echos, Explosif antigrisouteux, Explosif de mine, Explosif nitraté, Formule 226, Fortex, NT (Explosif), NX (Explosif), Schneiderite, Sofranex A, Tolamite and others.

Nitrate de guanidine — NITROGUANIDINE

Although Nitroguanidine has been known in France for many years, it does not seem that it was used in explosive & propellant compositions prior to WW II. There are many post-WW II references in the French literature describing the preparation, manufacture, properties & uses of Nitroguanidine in explosive mixtures.

Nitrate de trinitrophénylnitramino-éthanol or Pentryl — PENTRYL

See Pentryl.

Nitrate d'urée — UREA NITRATE

Urea Nitrate, a powerful explosive, was prepared & examined in France by L. Médard [Mémorial des Poudres (Paris) 33, 113-15 (1951)]. It was prepared by the method of G. Darzens & L. Levy by treating an aqueous solution of urea with nitric acid at a low temperature.

Nitrate d'urée (cont'd)

It was obtained as colorless crystals in 90% yield as the technical product. Its melting point is 155°C (with decomposition); loss in weight after 100 hours at 85°C, about 1%; Trauzl test value 80% (Picric Acid = 100%); and velocity of detonation 4700 meters/second at density 1.20 gm/cc.

Nitrocellulose — NITROCELLULOSE

See also Coton-poudre.

Nitroglycérine — NITROGLYCERIN

Nitroglycerin is manufactured in France by the batch process of Nathan. The apparatus used before WW II by the Société Nobel Francaise and the properties of Nitroglycerin are described by:

P. Pascal, "Explosifs, Poudres, Gaz de Combat", Hermann, Paris (1930), pages 90-98;

L. Vennin, E. Burlot et H. Lécorché, "Les Poudres et Explosifs", Béranger, Paris (1932), pages 315-29;

J. Pepin Lehalleur, "Traité des Poudres, Explosifs et Artifices", Ballière et Fils, Paris (1935), pages 204-5.

Nitroglycerin is used as an ingredient of Propellants, and in a number of commercial & military explosives. See Cellamite, Dynamite, Formule 226, Nobélite, Sofranex A, Tolamite and others.

Nobélite — NOBÉLITE GELATIN DYNAMITE

A plastic explosive manufactured before & after WW II by the Société Nobel Française contains Nitroglycerin 20%, Collodion Cotton 1.6%, sodium nitrate 60%, liquid Dinitrotoluene 14%, woodflour 4.3% & sodium bicarbonate 0.1%. Its CUP (Coefficient d'utilisation pratique) value is 78% (Picric Acid = 100%), but it is difficult to initiate.

See also Tolamite.

NPMn (Explosif) — BOOSTER

See Relais (Explosif pour).

NT (Explosif) (Nitrate d'ammoniaque-Tolite) — AMATOL

A military explosive consisting of Ammonium Nitrate 70% & TNT 30%. This castable composition corresponds to US 70/30 Amatol.

NTMX (Explosif) (Nitrate d'ammoniaque-Trinitrométaxylène) — NTMX (EXPLOSIF)

An explosive composition consisting of Ammonium Nitrate 78% & Trinitroxylene 22%. It is used as a bursting charge in Projectiles.

NX (Explosif) (Nitrate d'ammoniaque-Xylite) — NX (EXPLOSIF)

An explosive composition consisting of Ammonium Nitrate 70% & Trinitroxylene 30%. It is used as a bursting charge in Projectiles.

OC (Explosif) — CSE (EXPLOSIF)

See CSE (Explosif).

P (Explosif) — CHEDDITE

See Explosif P.

Pentaglycérine trinitrate — PENTAGLYCERIN TRINITRATE

See Trinitrate de pentaglycérine.

Penthrite or Tetranitropentaérythrite — PETN

PETN has been known in France for many years and has been studied by many investigators in France since WW II.

It is used straight in Cordeau détonant (Primacord), and in some composite explosive such as CSE (Explosif), Explosif antigrisouteux Explosif nitraté, Explosif plastique, Pentolite, Relais (Explosif pour), Sevranite and others.

Pentolite — PENTOLITE

Mixtures of PETN & TNT such as 50/50 and 67/33 proportions are used as castable bursting charges in Projectiles. The 20/80 PETN/TNT mixture is used in some composite explosives, such as CSE (Explosif) & Explosif nitraté.

The thermal stabilities of Pentolites were studied after WW II by G. Desseigne, Mémorial des Poudres (Paris) 32, 137-44 (1950). It was found that these mixtures have lower thermal stabilities than either of the components, PETN or TNT. There was reported perceptable decomposition of Pentolite even at 90°C.

See also Explosif nitraté.

Pentryl or Nitrate de trinitrophénylnitraminoéthanol — PENTRYL

The preparation of Pentryl was accomplished by condensation of 1-chloro-2, 4-dinitrobenzene with ethanolamine, and nitrating the product, 2,4-dinitrophenylethanolamine, with mixed nitric-sulfuric acid.

The properties of Pentryl were determined and compared with Picric Acid & Tetryl as follows:

	Picric Acid	Tetryl	Pentryl
Maximum Pressed Density, gm/cc	1.63	1.68	1.72
Velocity of Detonation, meters/second (density 1.60 gm/cc)	7100	7300	7300
Power or CUP value, %	100	114	126
Impact Sensitivity, kilogram meters	5.0	2.10	1.50

The purified Pentryl recrystallized from alcohol melts at 127°C.

Ref: L. Médard, Mémorial des Poudres (Paris) 33, 47 & 51 (1951) and G. Desseigne, "Procédé de Préparation du Pentryl", Mémorial des Poudres (Paris) 33, 255-64 (1951).

Picrate d'ammoniaque — AMMONIUM PICRATE

There is no information to indicate that Ammonium Picrate is used straight as a military explosive in France. It is known to have been used in a composite explosive called Brugère Poudre.

Poudre brune — BROWN POWDER

See under Poudre noire.

Poudre de mine — DYNAMITE

See Dynamite.

Poudre Favier — DYNAMITE

See Dynamite.

Poudre noire — BLACK POWDER

The French method of manufacturing Black Powder is essentially the same as that used in other countries.

The compositions & types of Black Powders manufactured in France prior to WW II are as follows:

Name	Type	Nitrate	Sulfur	Charcoal
Poudre de guerre	Military Powder	75	12.5	12.5
Poudre de mine forte	Strong Blasting Powder	75	10	15
Poudre de mine ordinaire	Ordinary Blasting Powder	62	20	18
Poudre de mine lente	Slow Blasting Powder	40	30	30
Poudre de chasse	Sporting Powder	78	10	12
Poudre brune	Brown Powder	78	3	19

A Black Powder composition used in mining operations consisted of sodium nitrate 75%, sulfur 10% & lignite (brown coal) 15%.

Poudre verte (Green Powder) — CHEDDITE

A French Green Powder is composed of Picric Acid 19%, Potassium Chlorate 66.5% & potassium ferrocyanide 14.5%. This composition rapidly aquires a yellow color when exposed to a humid atmosphere.

Pyrocollodion — NITROCELLULOSE

A name for Nitrocellulose of 12.75% Nitrogen content.

Pyrotechnie or Artifices — PYROTECHNICS

French Pyrotechnic Compositions, called Artifices, may be divided into the following four classes:

1) Artifices lumineux (Iluminating Pyrotechnics) - used for night signals.

2) Artifices fumigènes (Smoke-Producing Pyrotechnics) - used for day signals.

3) Artifices incendiaires (Incendiary Pyrotechnics). Examples are Calorite française & Mélange Massenet.

4) Artifices de signalisation sonore (Pyrotechnic sound-producing devices).

Some examples of French Pyrotechnic compositions used are the following:

Ignition composition for tracer bullets - barium peroxide 71.5%, magnesium powder 15%, gumlac 8.5% & pulverized walnut shells 5%.

Composition for Véry pistol cartridges - barium nitrate 57%, aluminum powder 30%, antimony trisulfide 6%, cryolite (sodium—aluminum fluoride) 6% & castor oil (or vaseline) 1%.

White star compositions a. barium nitrate 70.5%, aluminum powder 19%, aluminum grains 9.5% & castor oil (or vaseline) 1%; b. barium nitrate 35%, aluminum powder 43%, cryolite 10%, antimony trisulfide 10% & vaseline 2%.

Red star compositions a. Potassium Chlorate 67 parts, strontium oxalate 13.5 parts, strontium carbonate 13.5 parts & shellac 6 parts;

Red star compositions (cont'd)

b. Potassium Chlorate 76%, strontium oxalate 11%, strontium carbonate 6.5% & shellac 6.5%; c. Potassium Chlorate 64.5%, strontium oxalate 10.7%, strontium carbonate 10.7%, shellac 13.4% & castor oil (or vaseline) 0.7%.

Red smoke composition - Potassium Chlorate 29%, Rhodamine 39% & lactose 32%.

Green star compositions a. Barium Chlorate 85%, shellac 12% & carbon black 3%; b. Barium Chlorate 90%, shellac 8% & castor oil (or vaseline) 2%.

Pyroxyle — GUNCOTTON

One of the names for Guncotton. See also Fulmicoton.

Pyroxyline or Collodion — NITROCELLULOSE

See Collodion.

Relais (Explosif pour) — BOOSTER

A Booster explosive mixture of 95/5 PETN/mononitronaphthalene, compressed to a density of 1.6 gm/cc, was used to determine the velocity of detonation of Ethylenediaminedinitrate. This work is described by A. Le Roux, Mémorial des Poudres (Paris) 32, 123 (1950).

The above Booster explosive mixture is called Mélange NPMn 95/5 by L. Médard [Mémorial des Poudres (Paris) 33, 339 (1951)] who used it compressed to 1.6 gm/cc density in 30 mm diameter cartridges having charge weights from 10 to 50 grams. It is claimed that this mixture possesses the same initiating efficiency as straight PETN, but is easier to compress and does not break on handling as does straight PETN.

Another Booster explosive, called "Relais d'acide picrique cristallisé" by Médard consists of crystalline Picric Acid packed to a density of 1.10 gm/cc in kraft paper cylinders 30 mm in diameter containing charge weight from 10 to 50 grams.

Schneiderite or Explosif S — SCHNEIDERITE

A military explosive composition consisting of a mixture of Ammonium Nitrate & Dinitronaphthalene in various proportions, such as 7/1, 87/13 or 88/12. This explosive has been used since WW I as a bursting charge in medium size Shells. Schneiderite has been used also in Italy and in Russian under the name Shneiderit (qv).

More recent explosives such as Ammonite, MDN (Explosif), N n° 1b, N n° 1c, N n° 1d, N n° 7, NX (Explosif) & NTMX (Explosif) may be considered as modifications of Schneiderite.

Sevranite — PLASTIC EXPLOSIVE

Some plastic explosives developed since WW II, and containing no Nitroglycerin, are called Sevranite.

Sevranite n° 1. Described under Explosif plastique.

Sevranite n° 2. This composition consists of Ammonium Perchlorate 42%, PETN 42% and plasticizer (prepared by dissolving 1 part of polyvinyl chloride in 15 parts of liquid Dinitrotoluene) 16%. This explosive compressed to a density of 1.55 gm/cc has a velocity of detonation of 7000 meters/second. It may be considered a modification of Sevranite No. 1 which contains 3% aluminum.

Sofranex A — PLASTIC EXPLOSIVE

A plastic mining explosive, placed on the market in 1948 by the Société Française des Explosifs, consists of Ammonium Nitrate 48%, Nitroglycerin 40%, Collodion Cotton 2%, aluminum powder 8% & liquid Dinitrotoluene 2%. This composition shows good resistance to water, and it has a CUP value of 144% (Picric Acid = 100%).

[Ref: L. Médard, "Progrès Récents et Tendances Actuelles dans les Explosifs de Mine en France", Mémorial des Poudres (Paris) 32, 217-18 (1950)].

Styphnate de plomb or Trinitrorésorcinate de plomb — LEAD STYPHNATE

It is used in Primer Compositions for the initiation of secondary explosives.

T4 — RDX

See Hexogène.

Tétranitrométhylamine or Tétryl | TETRYL

See Tétryl.

Tétrazène | TETRACENE

It is used as an ingredient of Primer Compositions for the initiation of secondary explosives.

Tetryl or Tétranitrométhylamine | TETRYL

Tetryl is manufactured in France by the method of L. Desvergnes: Monomethylaniline is nitrated in two stages - 1) By treating it with sulfuric acid to form the sulfate, and than with mixed nitric-sulfuric acid at 20-25°C. 2) By nitrating the resulting yellow Dinitromethylaniline (yield 85%) with mixed nitric-sulfuric acid, first at 50-70°C and then at 95°C for one hour. The resulting product is Tetryl in 95% yield.

It is claimed that the Desvergnes method is more economical, from the point of view of acids used, than the one-stage nitration of methylaniline.

Tetryl is seldom used alone as a booster explosive charge, but sometimes in composite explosives such as Fortex & Tétrytol, and in some Priming & Initiating Compositions (See under Fulminate de mercure).

Tolamite | PLASTIC EXPLOSIVE

A plastic mining explosive, placed on the market in 1948 by the Société Francaise des Explosifs, consists of Ammonium Nitrate 61%, Nitroglycerin 27% Collodion Cotton 1%, liquid Dinitrotoluene 9.5% & woodflour 1.5%. This composition has a CUP value of 131% (Picric Acid = 100%). [Ref: L. Médard, "Progrès Récents et Tendances Actuelles dans les Explosifs de Mine en France", Mémorial des Poudres (Paris) 32, 217 (1950)].

Tolite, Trotyl or Trinitrotoluène | TNT

Several grades of TNT were used in France prior to WW II:

Tolite D. TNT of high purity (setting point 80.6°C) was prepared by washing Tolite T with a 2-3% cold solution of sodium sulfite.

Tolite, Trotyl or Trinitrotoluene (cont'd)

Tolite M. Crude TNT of setting point 78-79°C.

Tolite O. Crude TNT of setting point 79-80.1°C.

Tolite T. TNT of setting point 80.1-80.6°C obtained by purification of crude TNT with sulfuric acid.

TNT is sometimes used straight as a bursting charge in ammunition, but extensively in composite explosives such as Amatol, Baratol, CSE (Explosif), Explosif antigrisouteux Explosif nitraté, Hexolite, Kaipinite, MTTC (Explosif), MTX (Explosif), NT (Explosif), Pentolite and others.

Triméthylènetrinitramine — RDX

A misnomer, for Cyclotriméthylènetrinitrame, often appearing in the French literature. This compound is also called in French T4 or Hexogène. See Hexogène.

Trinitrate de pentaglycérine — PENTAGLYCERIN TRINITRATE

A systematic study of the nitration of pentaglycerin has led to the development of a continuous process for the industrial preparation of Pentaglycerin Trinitrate,

$$\begin{array}{l} \qquad\quad CH_2ONO_2 \\ H_3C\text{--}C\text{--}CH_2ONO_2. \\ \qquad\quad CH_2ONO_2 \end{array}$$

The most economical process involves the following proportions & conditions: One hundred grams of pentaglycerin in 470 gm of 100% sulfuric acid, 400 gm of 97% nitric acid, and 100 gm of oleum (20% SO_3) at 70°C in a nitrator for 15 minutes are sufficient for complete reaction. Following nitration, the mixture is received in a decanter for the separation of supernatant Pentaglycerin Trinitrate, which is washed in a baffle column with air injection. The yield is 97-98%.

Pentaglycerin Trinitrate is colorless, odorless oil with a flat taste. It turns yellow on standing. Other properties determined are as follows: Density 1.4685 at 20°C, freezing point -60°C, refractive

Trinitrate de pentaglycerine (cont'd)

index 1.4760 at 17.5°C, viscosity (discharge of a 10-ml pipet at 20°C) 148 seconds, solubility in water 0.516 gm /liter at 19°C, impact sensitivity (for 50% detonations) 0.59 kg, and gelatinizes Nitrocellulose (11.7% Nitrogen) only slightly.

This compound is proposed as a substitute & eventual replacement for Nitroglycerin. [Ref: R. Colson, Mémorial des Poudres (Paris 30, 43-58 (1948) & Chemical Abstracts 45, 8249-50 (1951)].

Trinitrométaxylène or Xylite — XYLITE

See Xylite.

Trinitrophénol, Mélinite or Acide picrique — PICRIC ACID

See Mélinite.

Trinitrorésorcinate de plomb or Styphnate de plomb — LEAD STYPHNATE

See Styphnate de plomb.

Trinitrotoluène, Trotyl, or Tolite — TNT

See Tolite.

Xylite or Trinitrométaxylène — XYLITE

Trinitrometaxylene is obtained by either one-, two-, or three-stage methods for the nitration of meta-xylene. This compound, in the form of golden-yellow needles, is a comparatively weak explosive and therefore is not used alone. It is very cheap and is used extensively in admixtures with Picric Acid, TNT & Ammonium Nitrate.

One mixture designated Xylite P consists of Picric Acid 50%, TNT 40% & Xylite 10%. This composition, melting at 85°C, has been used as a bursting charge in some Projectiles.

See also the composite explosives MTX (Explosif), NX (Explosif) & NTMX (Explosif).

Unusual Research & Development in the Field of Explosives

The batch process for the manufacture of HMX is being studied at Poudrerie Nationale de Sorgues, France. Nitration is identical to that of the US process. The use of paraformaldehyde does not affect the yield and the French do not intend to use it. In other instances the French depart radically from the US process. Instead of diluting the nitration mix with water and heating for one hour, they filter & separate the product from the spent acid after cooling it to 20°C. The filter cake is washed with cold water and then with hot water. The HMX is then "stabilized" by heating it at 95°C for five hours in 0.5% nitric acid. The product is claimed to be 100% HMX, melting at 275°C. Yields in the laboratory are 60% of theoretical based on hexamine & 50% in the semi-works plant.

A continuous process for the manufacture of HMX is being studied both in the laboratory & in semi-plant operations. This is a conventional overflow system consisting of five stainless steel beakers, of one liter capacity, in a series. All the first stage raw materials are added in the first beaker; the first aging takes place in the second beaker; the second stage ingredients (a 15/8 ratio of HNO_3/NH_4NO_3 is used instead of 15/14) are added in the third & fourth beakers; and final aging takes place in the last beaker. The capacity of the process is 700 grams of HMX per hour.

Research in Primary Explosives

Electric Detonators having a circular gap, with a gap width of 50 $\pm$ 2 microns, are being studied in France. The plugs are either sprayed with a graphite suspension or coated with a metal film by means of vacuum evaporation. One feature of these studies is the effect of sulfur on silver films. The plugs are used for multilayer Detonators containing PETN surrounded by a primary explosive. The delay times of the Detonators are determined by means of an electronic timer having a resolving time of 1/40 microsecond.

Research is in progress to substitute Silver Azide for Lead Azide or Lead Styphnate. The reason for this study is that Silver Azide has a higher electrical sensitivity and a smaller particle size which should make it more suitable for small gap Detonators. There is also interest in silver coating Lead Azide.

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German Explosives

Beginning in the middle 1930's, the Germans foresaw the possibility of a war and began the development of explosives which could be used to replace those prepared by the nitration of aromatic hydrocarbons, derived from coal tar. The most important of these "new" explosives were Hexogen (RDX) & Pentrit (PETN). Both are derived from aliphatic compounds of which no shortage was expected in the event of war. In addition, these explosives are more powerful than TNT, Picric Acid, or Tetryl but they are too sensitive to be used alone as bursting charges in shells. This difficulty was overcome by coating RDX & PETN with 10% of wax applied in a molten condition. Such explosive mixtures could be safely press loaded into projectiles; however, they could not be cast loaded because of their high melting points. When it was desired to cast load shells, the Germans mixed RDX or PETN with about equal parts of low-melting explosives, such as Dinitrobenzene or TNT.

In addition to these superior explosives, the Germans began the development before WW II of some rather inferior explosives which were called Ersatzsprengstoffe (Substitute explosives).

At the beginning of WW II, the Germans did not have a shortage of aromatic hydrocarbons and were able to use, as bursting charges in shells, such explosives as TNT, Dinitrobenzene, Picric Acid, Tetryl & Hexanitrodiphenylamine. For underwater charges the Germans incorporated about 15% aluminum into their high explosives, as they had done during WW I. The enormous demand for explosives and the shortage of raw materials created a situation during WW II which made it necessary to use substitutes inferior to TNT, thus lowering the efficiency of the ammunition.

The principal explosives known to have been used or studied during & after WW II are listed alphabetically in the following pages.

Abonachit 2

ABONACHIT 2

See Füllpulver Nr 57 under Fülpulver.

Albit

ALBIT
DYNAMITE

A blasting explosive consisting of Sodium Perchlorate 80%, Dinitronaphthalene 12%, wood meal 3%, phenanthrene 3% & Nitroglycerin 2%. This explosive, also called Gesteins-Albit (Rock-blasting Albit), is suitable for blasting rocks, ores, construction etc, but not suitable for use in gaseous coal mines.

Aldorfit

ALDORFIT
AMMONIUM NITRATE DYNAMITE

A Favier-type blasting explosive developed and manufactured in Switzerland but used extensively in Germany. Several formulations are known, of which Aldorfit-pulverförmig is the oldest. It consists of Ammonium Nitrate 81%, TNT 17% & wood meal 2%. Its properties are: Density 0.9 to 1.05 gm/cc; mp deflagrates above 360°C; heat of explosion 1025 kcal/mole (water vapor); volume of gas developed on explosion 890 liters/kg; temperature developed on explosion 2900°C; velocity of detonation 4500 meters/sec; impact sensitivity 100 cm with 2 kg weight; Trauzl test value 369 cc vs 311 cc for TNT; and brisance by copper cylinder compression test 1.89 mm vs 2.86 mm for TNT.

Some later formulations contain 21% TNT; Aldorfit LL-aluminiumhaltig contains aluminum but its composition is not reported. Its Trauzl test value is 432 cc vs 311 cc for TNT.

Alkalsit

ALKALSIT
CHEDDITE

A pre-WW II Cheddite-type blasting explosive consisting of Potassium Chlorate 28%, Ammonium Nitrate 25%, potassium or sodium nitrate 30%, a nitrocompound (such as TNT) 11.5%, wood or cereal meal 2.5%, resin (such as colophony) 2.5% & hydrocarbon 0.5%.

Amatol or Füllpulver (Fp)

AMATOL

40/60 Amatol (called Füllpulver Nr 13 or Fp 60/40) was used in General Purpose, Semi-Armor-Piercing and Antipersonnel Bombs & Shells.

Amatol or Füllpulver (Fp) (cont'd)

50/50 Amatol (called Fülpulver Nr 13 a or Fp 50/50) was used in General-Purpose Bombs, Shells and Land Mines, such as the Tellermine Disk-Type Antitank Mine.

60/40 Amatol (called Füllpulver Nr 88 or Fp 40/60) was in Shells, Grenades and Radio-Guided Bombs.

70/30 Amatol (called Fp 30/70) was used in Antipersonnel Bombs.

95/5 Amatol (called Fp 5/95) use is unknown.

German case markings, indicating Amatols, are pink with a blue diagnal stripe.

There are also German "Amatols" which contained no TNT but some other explosive. These are as follows:

Amatol 39a - A mixture developed by G. Römer as a bursting charge for the V-1 Rocket or, according to another source, a mixture developed in 1939 at the Krümmel Fabrik of Dynamit Aktiengesellschaft. This explosive consists of Dinitrobenzene 50%, Ammonium Nitrate 35% & RDX 15%. It is claimed to be as powerful as 40/60 Amatol (Fp 60/40). As it is difficult to cast load Amatol 39 uniformly in large-caliber Projectiles, the so-called "biscuit" method of loading was used. In this method a Projectile is alternately filled with pellets of "biscuit mixture A" (Ammonium Nitrate 50%, technical grade calcium nitrate 25%, PETN 10% & RDX 15%), and molten Amatol 39 cast at a temperature of 80°C. The resulting charge forms no cavities on cooling. Its density is 1.58 gm/cc; Trauzl test value 350 cc & lead block compression (Stauchprobe nach Hess) test value 17.5 mm.

The original Amatol 39 consisted of Ammonium Nitrate 35-45%, TNT 50% & RDX 5-15%.

Amatol 40 - This explosive consists of Dinitroanisole 50%, Ammonium Nitrate 35% & RDX 15%. It was cast loaded in the war head of V-1 Rockets.

A different composition also known as "Amatol 40" consists of Dinitrobenzene 50%, Ammonium Nitrate 35% & RDX 15%. This latter explosive was one of the German Ersatzsprengstoffe (substitute explosives).

Amatol 41 - This "Ammonite-type" explosive consists of Ammonium Nitrate 52%, technical grade calcium nitrate 6%, Ethylenediamine Dinitrate (called PH-Salz in German) 30%, RDX 10% & montan wax 2%. It was used as a bursting charge in Bombs.

See also Amatol-type fillers listed under Füllpulver.

Ammonal or Ammonpulver — AMMONAL

In addition to the compositions listed in Tables 2 & 3, General Index, some other military compositions include:

Fullpulver Nr 19 (abbreviated as Fp Nr 19): Ammonium Nitrate 35%, TNT 55% & aluminum 10% used in some Artillery Shells.

Füllpulver Nr 13-113 (abbreviated as Fp Nr 13-113): Ammonium Nitrate 70%, TNT 20% & aluminum 10% used in General-Purpose Bombs.

Fullpulver Nr 110 (abbreviated as Fp Nr 110): Ammonium Nitrate 90%, aluminum 2.5%, naphthalene 5% & wood meal 2.5% used press loaded in some Bombs.

Ammoncarbonit — AMMONCARBONIT, AMMONIUM NITRATE DYNAMITE

A type of permissible explosive which may be considered as intermediate between Carbonit & Ammonium Nitrate Explosives. Some compositions and their properties are as follows:

Ammoncarbonit - Ammonium Nitrate 80.3%, potassium nitrate 5%, Nitroglycerin 4%, Collodion Cotton 0.2%, carbohydrate 4.5% & coal dust 6%. Density 1.06 gm/cc & velocity of detonation 3380 meters/sec.

Ammoncarbonit I - Ammonium Nitrate 82%, potassium nitrate 10%, Nitroglycerin 3.8%, Collodion Cotton 0.2% & wood meal 4%. Density 1.11 gm/cc; Trauzl test value 355 cc; and velocity of detonation 3195 meters/second.

Ammoncarbonit II - Ammonium Nitrate 56.4%, sodium nitrate 7%, Nitroglycerin 5%, glycerin 5%, carbohydrate 4% & alkali chloride 22.6%. Oxygen balance +10% & Trauzl test value 210 cc.

See also Carbonit & Extracarbonit.

Ammondynamit

AMMONDYNAMIT
AMMONIUM NITRATE DYNAMITE

A type of straight Dynamite consisting of Ammonium Nitrate 30%, Nitroglycerin 63%, Collodion Cotton 2% & wood meal 5%. Its oxygen balance is +1.5%; density 1.44 gm/cc; Trauzl test value 485 cc; lead block crushing value 21 mm; velocity of detonation 7000 meters/sec; heat of explosion (water vapor) 1300 kcal/kg; and temperature developed on explosion 2770°C.

This type of explosive was not very popular in Germany but was used in France & in the USA.

See Dynamit.

Ammongelatine

AMMONGELATINE
AMMONIUM NITRATE DYNAMITE

A permissible type of mining explosive used in Germany since WW I. Some typical compositions are as follows:

Ammongelatine - Dinitrochlorohydrin (of which up to 5% of total explosive may be replaced by Nitroglycerin) 28-33%, Collodion Cotton 1-3%, Ammonium Nitrate 45-50%, alkali nitrate 10-15%, a nitrocompound (such as nitrotoluene, nitronaphthalene or nitrodiphenylamine) 6-12% & vegetable meal 0-2%.

Ammongelatine 2 - Dinitrochlorohydrin 21-24%, Collodion Cotton 0.5-0.7%, Ammonium Nitrate 61-65%, Dinitrotoluene 7-8%, carbohydrate (maximum) 1.5% & aluminum 1.5-2.5%.

Deutsche Ammongelatine - Dinitrochlorohydrin (containing 15-20% of Nitroglycerin) 30%, Collodion Cotton 3%, Ammonium Nitrate 45%, sodium nitrate 10%, a mixture of DNT/TNT 10% & wood meal 2%. Its properties are: Density 1.45; Trauzl test value 400 cc; volume of gases at NTP 771 liters/kg; heat of explosion 1101 kcal/kg; temperature developed on explosion 2570°C; specific pressure 8195 atmospheres; brisance by Kast formula 82,000; and velocity of detonation 6900 meters/second.

See also Dynamit & Gelatinedynamit.

Ammonit — AMMONITE

Many types of Ammonites are used in Germany. Their general compositions are; Ammonium Nitrate 70 to 88% (of which 10% can be replaced by potassium nitrate), aromatic nitrocarbons 7 to 20% & vegetable meal (with or without a solid hydrocarbon) 1 to 6%. Other Ammonites contained up to 4% Nitroglycerin, 3 to 10% Potassium Perchlorate, or 2 to 12% aluminum. Some compositions are known as Astralit (qv), Donarit (qv) and Aldorfit (qv).

Some Ammonites developed during WW II for military purposes are given in Table 4, under AMMONITE.

Ammoniumnitrat, Ammonnitrat or Ammonsalpeter — AMMONIUM NITRATE; AMMONIUM NITRATE DYNAMITE

It is used in a number of blasting explosives, permitted for use in coal mines, which are called Schlagwettersichere Sprengstoffe, Sicherheits Sprengstoffe and Ammonalsalpeter Sprengstoffe. They contain Ammonium Nitrate as the principal ingredient and not more than 4% Nitroglycerin if it is present in the mixture.

Ammonium Nitrate is also used in composite military explosives such as Abonachit 2 or Füllpulver Nr 57, Berclavit B, Amatol or Füllpulver, Ammonal or Ammonpulver, Donarit or Füllpulver Nr 56, Formit; Füllpulver Nrs: 13, 13a, 13-113, 17a, 19, 20, 21, (?), 52, 52a, (?), 64, 84, 102, 110, 111, 112; Hexa Sprengstoffe, Nitrobaronit, Nitrolit, and others.

Ammoniumpikrat — AMMONIUM PICRATE

No information available as to its uses in Germany.

Ammoniumsalpeter or Ammonsalpeter — AMMONIUM NITRATE

See Ammoniumnitrat.

Ammonpulver or Ammonal — AMMONAL

See Ammonal.

Ammonsalpeter Sprengstoff — AMMONIUM NITRATE DYNAMITE

AS-3 | AS-3

One of the German Priming or Igniting Compositions consisting of red lead (lead oxide, Pb_3O_4) 77%, silicon 19% & Nitrocellulose (suspended in acetone) 4%. It was used during WW II in the electric fuseheads of some Electric Detonators.

See also fuseheads under Bleipikrat and Initialsprengstoffe (Initiating Explosives) & Zündhütchensätze (Priming Compositions).

Astralit | ASTRALITE DYNAMITE

It is an Ammonium Nitrate Dynamite now used in general blasting operations. It was used during WW I as a main filler for Trench Mortars & Hand Grenades. See Table 8 under ASTRALITE.

Berclavit B | BERCLAVIT B

This is an early German, aluminized Ammonium Nitrate explosive. It was examined after WW II by L. Médard [Mémorial de l'Artillerie Française (Paris) 22, 569 (1948)]. It consists of Ammonium Nitrate 79.5%, Dinitrotoluene 5%, Nitroglycerin 5%, Collodion Cotton 0.5%, cellulose 5% & aluminum 5%. Its CUP (French lead block expansion test) value is 125% (Picric Acid = 100).

Bikarbit | BIKARBIT DYNAMITE

This is a type of permissible explosive containing large amounts of sodium bicarbonate & small amounts of Nitroglycerin. These explosives were patented by Westfälisch-Anhaltische Sprengstoff Aktiengesellschaft, Germany before WW II. Mixtures containing as much as 95% sodium bicarbonate & as little as 5% Nitroglycerin can still be initiated by ordinary blasting caps.

The following composition is an example of one Bikarbit: Sodium bicarbonate 50%, sodium chloride 35% & Nitroglycerin 15%. Its properties are: Temperature developed on explosion 400°C; velocity of detonation 2500 meters/second; heat of explosion 162 kcal/kg; density 1.35 gm/cc; Trauzl test value 30 cm; specific pressure 610 atmospheres; brisance by Kast formula 2.06; gap test value 40 cm; volume of gases evolved on explosion of 1 kg is 258 liters (water vapor) at STP; and required for initiation, at least a No. 2 blasting cap.

Bikarbit (cont'd)

When a more brisant explosive is desired the composition is modified as follows: Sodium bicarbonate 40%, sodium chloride 12.5%, sodium nitrate 13%, Nitroglycerin (slightly gelatinized) 30% & wood meal 4.5%. Its properties are: Temperature developed on explosion 1400°C; velocity of detonation 4000 meters/second; density 1.4 gm/cc; Trauzl test value 124 cc; gap test value 30 cm; and required for initiation, a No. 2 blasting cap.

The Bikarbits proved to be very safe for use in gaseous or dusty coal mines.

Bittersäure (Bitter Acid) — PICRIC ACID

See Pikrinsäure.

Bleiazid — LEAD AZIDE

It was used in Priming & Initiating Compositions. Lead Azide was prepared in Germany during WW II, at the Wolfratshausen Plant of Dynamit A-G, from sodium azide & lead nitrate in the presence of dextrin. In order to destroy any Lead Azide remaining in the mother liquor, about 5 liters of nitric acid & about 1/2 liter of concentrated sodium nitrite solution were added per batch of Lead Azide.

The technical grade Lead Azide (purity 92-94%) used in German Sprengkapsel A & Sprengkapsel B (commercial Detonators) becomes dead pressed when the loading pressure exceeds 900 kg/sq cm (12,800 psi). Perfectly dry Lead Azide can withstand higher pressures, but the technical grade contains up to 0.35% moisture.

See also Detonatoren- und Sprengkapseln- Ladungen (Detonator & Blasting Cap Charges) and Initialsprengstoffe (Initiating Explosives), & Zündhütchensätze (Priming Compositions).

Bleipikrat — LEAD PRICRATE

It was used as one ingredient in the preparation of ignition mixtures f-r fuseheads of Electrical Detonators. It was prepared by the action of lead nitrate on Picric Acid. Some manufacturers preferred the Lead Picrate/nitrated organic compound mixture to the Potassium Chlorate/Lead Sulfocyanate or Mercury Fulminate/Potassium Chlorate mixtures also used.

Bleipikrat (cont'd)

A low-tension fusehead (designated"A6") introduced during WW II, as a substitute for fusehead "G3", was prepared at Troisdorf Fabrik by dipping the tip of a bride wire: a. First into Lead Picrate (90 gm) & silicon (10 gm), all suspended in 75 cc of a 2% solution of Nitrocellulose in either amyl or butyl acetate. b. After drying of the first dip, a second dip was made into Lead Picrate (50 gms), lead chromate (35 gm) & silicon (15 gm), all suspended in 75 cc of 3% Nitrocellulose, amyl or butyl acetate solution. c. Third dip was a lacquer consisting of 15% Nitrocellulose in 75/25 butyl acetate/ ethanol solution, to which was added Sipalin AOM (20% dry weight of Nitrocellulose), the methylcyclohexyl ester of adipic acid. d. The fourth dip was the same as the third, except it contained 0.8 gm of Sudan Brown per each 10 liters of lacquer.

Before it became difficult to obtain cerium-magnesium metals necessary for the preparation of "Mischmetall" (mixed-metal), the Germans used a "fusehead G3" composition of Lead Picrate, Mischmetall & alder wood charcoal, and a dipping process as above to prepare low-tension fuseheads for Electric Primers & Detonators.

See also AS-3.

Bleistyphnat or Bleitrinitroresorcinat — LEAD STYPHNATE

Lead Styphnate was prepared during WW II, at the Wolfratshausen Plant of Dynamit A-G & at the Troisdorf Plant, by two methods, all vessels used being the same as those used for the manufacture of Lead Azide:

1) Trinitroresorcinol (called "Trizin") was stirred in water containing magnesium oxide to obtain magnesium Trinitroresorcinate in solution. To this solution preheated to 60°C, aqueous lead nitrate was gradually added to the stirred solution. After cooling to 20°C, the mother liquor was decanted, leaving the precipitated Lead Styphnate. Any Lead Styphnate remaining in the mother liquor was destroyed by adding sodium carbonate, which produced sodium styphnate & precipitated lead carbonate. The remaining liquid was acidified with waste acid & reduced to a non-explosive triamine by iron filings.

2) By mixing boiling solutions of Trinitroresorcinol (Styphnic Acid), previously neutralized with sodium carbonate, & lead nitrate.

Bleistyphnat (cont'd)

Lead Styphnate has been used as an Initiating Explosive in Germany since 1920 when the so-called "Trizinatkapseln" (Lead Styphnate Caps) were put on the market by the Rheinisch-Westfälische Sprengstoffe A-G. See also Detonatoren- und Sprengkapseln-Ladungen (Detonator & Blasting Cap Charges) and Initialsprengstoffe (Initiating Explosives) & Zündhütchensätze (Priming Compositions)

Brandstoffe or Brandsätze & Brandbomben — INCENDIARY COMPOSITIONS

Some German Incendiary Bombs contained white phosphorus either alone or in mixtures with highly combustible materials. Examples of such compositions are the following:

Brand C50A - Contained approximately 30 pounds of a mixture of phosphorus 4%, gasoline 86% & pure rubber 10%.

Brand C50B - Contained white phosphorus alone.

Brand 250A - Types I & II contained petroleum 87.8%, polystyrene 11.7% & phosphorus 0.5%.

Other Incendiary Bombs, called Flammbombe, contained an oil mixture & a HE bursting charge:

Flam C250A (B or C)-Contained 50 kg of an oil incendiary mixture & a TNT bursting charge.

Flam KC250 - Contained the same filling as above.

Flam C500 - Contained an incendiary oil of 70% petroleum & 30% TNT, with a TNT bursting charge.

A combination Demolition-Incendiary Bomb, called Sprengbrand CB Bombe, was the same shape as conventional HE Bombs but its filling was different. The nose section contained 20 lbs of TNT and behind the charge was placed the fuze pocket. In the fuze pocket was located a bakelite gaine containing a Black Powder biscuit, and a steel encased gaine containing a delay pellet & detonator. A diaphram divided the Bomb in two sections, one containing a silk bay of Black Powder which served both as igniting & expelling charge for the middle section containing incendiaries. The explosion of the Black Powder charge also sheared the screws securing the base plate and ejected the incendiary elements over a radius of 100 yards. About one second later, the delay element in the booster reached the detonator, which fired the TNT charge in the nose of the Bomb.

Brandstoffe or Brandsätze & Brandbomben (cont'd)

Most German Incendiary Projectiles consisted of an "Elektron" (such as magnesium-aluminum alloys) casing filled with Thermite (such as iron oxide 70-76% & aluminum 30-24%). One type of Projectile was filled with pea-size lumps of dried paper pulp, followed by evacuation of air and running in of molten white phosphorus. Another type consisted of a steel outer case into which two tubes were inserted, the outer of celluloid & the inner of paper. The inner tube was filled with Thermite & the space between the two tubes was filled with naphthalene.

C6 — C6

A mixture developed during WW II as one of the substitutes for TNT. It consists of Man-Salz (Methylamine Nitrate) 50%, sodium nitrate 35% & RDX 15%. Its density of fragment test value (Splitterdichteprobe) is 39 meters (TNT - 40). This mixture was used as a castable bursting charge for Shells & Bombs.

See also Formit.

Cahücit — CAHÜCIT DYNAMITE

A safety blasting explosive consisting of potassium nitrate (or sodium nitrate) 70%, sulfur 12%, charcoal 8% & wood meal 10%. This and other Dynamites were manufactured by the Deutsche Cahüsit Werke AG, Gnaschwitz. See also Wettersprengstoffe. Similar Dynamites are used in England & in France.

Calcinit — CALCINIT DYNAMITE

A mining explosive containing large amounts of technical grade calcium nitrate [$Ca(NO_3)_2 \cdot 4H_2O$]. Several modifications of composition are reported:

Calcinit 1 - a. calcium nitrate 32-36%, Ammonium Nitrate 32-34%, Nitroglycerin 15-20%, wood meal 13-17% & liquid hydrocarbon (flash point 30°C or above) 0-2%; b. calcium nitrate 38%, Ammonium Nitrate 35.5%, Nitroglycol 6%, TNT 7.2%, Dinitrotoluene 4.8%, wood meal 8% & caput mortum dye (Fe_2O_3) 0.5%. This latter Dynamite was manufactured at the Krümel Fabrik of Dynamit Aktiengesellschaft, Germany.

Calcinit (cont'd)

Calcinit 2 - a. calcium nitrate 60-70%, Ammonium Nitrate 0-15%, Nitroglycerin 15-20%, charcoal and/or vegetable meal 6-15% & liquid hydrocarbon 0-8%; b. calcium nitrate 66%, Nitroglycerin 20% & charcoal 14%.

Carbonit — CARBONIT DYNAMITE

A class of permissible explosives which may be considered as straight Dynamite with the temperature of explosion lowered by an excess of carbon in the composition. As a class, Carbonits merge thru the Ammoncarbonits with the Ammonium Nitrate Explosives. Three compositions used in Germany are as follows:

Carbonit - Nitroglycerin 25%, potassium nitrate 30.5%, spent tan bark 40%, barium nitrate 4% & sodium carbonate 0.5%. Its heat of explosion is 576 kcal/kg; temperature developed on explosion 1874°C; Trauzl test value 235 cc; and velocity of detonation 2443 meters/second.

Carbonit 1 - Nitroglycerin 25%, sodium nitrate 30.5%, meal 39.5% & potassium dichromate 5%. Its heat of explosion is 536 kcal/kg; temperature developed on explosion 1666°C; Trauzl test value 240 cc; and velocity of detonation 3042 meters/second.

Carbonit II - Nitroglycerin 30%, sodium nitrate 24.5%, meal 40.5% & potassium dichromate 5%. Its density is 1.10 gm/cc; heat of explosion 602 kcal/kg; temperature developed on explosion 1640°C; Trauzl test value 258 cc; and velocity of detonation 3850 meters/second.

The Carbonits are considered to be quite safe for use in mines containing "fire damp", but their degree of safety in coal dust is questionable under certain conditions due to the combustibility of their gaseous products, particularly with a type containing potassium nitrate.

Carbonits are also used in England and in France with modified formulations.

See also Extracarbonit.

Cheddit

CHEDDITE

Two German Chlorate compositions consist of a. Potassium Chlorate 80%, liquid Dinitrotoluene 10%, TNT 5%, castor oil 4% & sawdust 1% and b. Potassium Chlorate 90% & heavy petroleum oil 10%.

German military Perchlorate Cheddites include the following compositions:

c. Potassium Perchlorate 56%, mononitronaphthalene 12% & Dinitrobenzene 32%.

d. Potassium Perchlorate 68%, Ammonium Nitrate 10%, Dinitrotoluene 16%, Nitroglycerin 4%, mononitronaphthalene 1% & wood meal 1%.

e. Potassium Perchlorate 35%, Ammonium Nitrate 42%, TNT/DNT 14%, Nitroglycerin 4% & wood meal 5%.

f. Potassium Perchlorate 34%, Ammonium Nitrate 48%, Dinitrotoluene 12% & wood meal 6%.

The above compositions d., e., & f. are also called Perchloratits. They are used in military & industrial demolition work.

See also Chloratit.

Chloratit

CHEDDITE
CHLORATIT

A Cheddite-type blasting explosive suitable for rocks, ores & general demolition, but not suitable for gaseous coal mines. Examples of some compositions are the following:

Chloratit 1 or Gesteins-Koronit T1 - Sodium Chlorate 72%, DNT/TNT 20%, Nitroglycerin 3-4% & paraffin 3-4% & vegetable meal 1-2%. Its oxygen balance is +3.0%; density in cartridge 1.57 gm/cc; heat of explosion 1250 cal/gm; temperature developed on explosion 3645°C; Trauzl test value 290 cc; lead block crushing value 20 mm; gap test value 8 cm; sensitivity to initiation, requires No. 3 Cap; and velocity of detonation 5000 meters/second.

Chloratit 2 or Gesteins-Koronit T2 - Sodium Chlorate 75%, DNT/TNT 20%, paraffin 3-4% & vegetable meal 1-2%. Its oxygen balance is +1.9%; density in cartridge 1.46 gm/cc; heat of explosion 1280 cal/gm; temperature developed on explosion 3700°C; Trauzl test value 280 cc;

Chloratit (cont'd)

lead block crushing value 19.5 mm; gap test value 8 cm; sensitivity to initiation, requires No. 1 Cap; and velocity of detonation 4300 meters/second.

Chloratit 3 or Miedziankit - Sodium Chlorate 83-91%, liquid hydrocarbons (flash point 30°C or above) 5-12% & vegetable meal 0-4%.

See also Cheddit.

Chloratsprengstoffe (Chlorate Explosives) — CHEDDITE

See Alkalsit, Cheddit, Chloratit, Gelatins-Cheddit under Gelatinedynamit, Gesteins-Persalit 2 under Gesteinsspregngstoffe, and others.

Detonatoren- und Sprengkapseln-Ladungen — DETONATOR AND BLASTING CAP CHARGES

Detonators are reinforced Blasting Caps which are designed to initiate explosives that are difficult to detonate by means of ordinary Blasting Caps. Some military Detonators examined at Picatinny Arsenal during WW II showed the following explosive charges:

Detonator R - Contained 4 grains of a mixture of Lead Azide 75% & Lead Styphnate 25%, over 6.9 grains of PETN.

Detonator T - Contained 3.9 grains of Lead Azide 42% & Lead Styphnate 58%, over 10.8 grains of Tetryl in an aluminum cap. Both of the above Detonators were used in HE Hand Grenades.

Some German Detonators used in Fuzes (sometimes called Gaines) include:

Gaine A - Consists of an upper charge of Lead Azide 59% & Lead Styphnate 41%; an intermediate charge of RDX; and a lower base charge of RDX 92% & wax 8%.

Gaine B - Consists of an upper charge of Lead Azide 69% & Lead Styphnate 31%; an intermediate charge of RDX; and a base charge of 92/8 RDX/wax.

Gaine Model 40 - Consists of an upper charge of Lead Azide & Lead Styphnate; and a base charge of PETN 87% & wax 13%.

Detonatoren- und Sprengkapseln-Ladungen

Detonator - Consists of an upper charge of Mercury Fulminate; and a base charge of Tetryl 49% & TNT 51%. It was used in Land Mines.

Gaine - Consists of an upper charge of Lead Azide 82%, antimony trisulfide 7% & abrasive 11%; and a base charge of PETN. It was used in 37 mm & 50 mm High Explosive Shells.

Gaine - Consists of an upper charge of Lead Azide with a cover charge of Black Powder; and a base charge of PETN/TNT. It was used in 47 mm Armor-Piercing Round Nose Shells.

Gaine - Consists of an upper charge of Lead Azide 14.4% & Lead Styphnate 85.6%; and a base charge of PETN. It was used in 47 mm Armor-Piercing Shells.

Gaine - Consists of an upper charge of Lead Azide 55% & Lead Styphnate 45%; and a base charge of PETN. It was used in 50 mm, 75 mm, 80 mm, 88 mm & 105 mm Shells.

The principal current commercial Detonators & Blasting Caps include the following:

Sprengkapsel A - Consists of an aluminum shell, 11 mm long & 4.36 mm diameter, filled with a 6 mm layer of PETN weighing 0.11 gm (base charge); and a 3 mm layer, weighing 0.16 gm of 80/20 Lead Azide/Lead Styphnate mixture, called "Michsatz" (prim mixture). Both charges are press loaded at 860 kg/sq cm.

Sprengkapsel B - Consists of an aluminum shell, 17 mm long & 7.98 mm in diameter, filled with a 6 mm layer of PETN weighing 0.40 gm (base charge); and a 4 mm layer of "Mischsatz" weighing 0.40 gm (primary charge). In both of these Caps the Lead Azide is technical grade, containing 92-94% PbN_6 and not more than 0.35% moisture.

Kupfer-Normalsprengkapsel Nr 8 (Normal Copper Cap No. 8) - Consists of a copper shell, 6.8 mm in diameter, with a 0.7 gm TNT base charge placed in two layers, each weighing 0.35 gm, and a 0.55 gm charge of Mercury Fulminate as the primary charge. All increments are press loaded at 480 kg/sq cm.

Detonator Briska Nr 8 - Consists of a shell, 40 mm long & 6.85 mm in diameter, filled with 0.8 gm of Tetryl (base charge) pressed at 2000 kg/sq cm, and 0.3 gm of a Lead Azide/Lead Styphnate mixture (primary charge).

Detonatoren- und Sprengkapseln-Ladungen (cont'd)

Detonator Nr 10 - This Detonator manufactured by Dynamit Aktiengesellschaft, Troisdorf Fabrik contained 1.25 gm of Tetryl as a base charge; and 0.3 gm of a Lead Azide/Lead Styphnate mixture as upper or primary charge.

See also Initialsprengstoffe (Initiating Explosives) & Zündhütchensätze (Priming Compositions).

Diamin — ETHYLENEDIAMINE DINITRATE

See PH-Salz.

DI-Salz — DIMETHYLAMMONIUM NITRATE

A German abbreviation for Dimethylammonium Nitrate, one of the Ersatzsprengstoffe (substitute explosives) prepared during WW II because of the shortage of TNT & other high explosives.

It was prepared by the reaction of dimethylamine with nitric acid (density 1.42 gm/cc). After vacuum distillation, a crystalline product was obtained which decomposed explosively above 120°C. This salt was found to be very unstable at temperatures above 100°C. In the decomposition of DI-Salz, it was observed that free dimethylamine & nitric acid were first produced. This was followed by oxidation of the dimethylamine, which resulted in the progressive formation of nitric oxides as well as carbon oxides. This reaction accelerated autocatalytically in an explosion. When the salt was dissolved in water & heated, strong hydrolysis took place.

No military application of DI-Salz was reported.

Donarit — DONARIT AMMONIUM NITRATE DYNAMITE

A type of Ammonium Nitrate Dynamite manufactured & used in Germany for many years. It is known that at least one Donarit, under the name Füllpulver Nr 56, was used for military purposes.

Donarit (cont'd)

Examples of some mining Donarits are as follows:

Donarit 1 (Gelatin type) - Ammonium Nitrate 55%, Nitroglycol 22%, Collodion Cotton 0.8%, sodium nitrate 10%, Dinitrotoluene (liquid) 6%, TNT 5%, wood meal 1% & caput mortum dye 0.2%.

Donarit 1 (Powdery type) - Ammonium Nitrate 81.5%, TNT 14%, Dinitrotoluene (liquid) 2%, wood meal 2% & caput mortum dye 0.5%.

Donarit 2 (Powdery type) - Ammonium Nitrate 84%, Nitroglycerin 4%, aromatic nitrocompounds 3% & wood meal 9%.

Another source reports that the three Donarits have the approximate composition: Ammonium Nitrate 86%, Nitroglycerin/Nitroglycol 4-6%, and TNT & aluminum 8-10%.

Both types of Donarit 1 were manufactured during WW II at the Krümmel Fabrik of DAG. The properties of Donarits have the following range in values: Density in cartridge 0.87-0.98; impact sensitivity with 2 kg weight 60-70 cm; Trauzl test value 355-435 cc; temperature developed on explosion 2580-3345°C; volume of gases, on explosion, at NTP 832-924 liters/kg; specific pressure 9900-10270 kg/sq cm; and velocity of detonation 3800-4850 meters/second.

See also Füllpulver Nr 56 under Füllpulver.

Dynamit — DYNAMITE

German Dynamites are usually divided into four groups: a) Guhrdynamit (Guhr Dynamite); b) Sprenggelatine (Blasting Gelatin); c) Gelatinedynamit (Gelatin Dynamite); and d) Sicherheitsdynamit (Safety Dynamite).

Between WW I & WW II the following Dynamites were used in coal mining:

Dynamit 1. Nitroglycerin 62.5%, Collodion Cotton 2.5%, Ammonium Nitrate (or sodium or potassium nitrate) 27% & vegetable meal 8%. Its properties are: Density in cartridge 1.45 gm/cc; temperature developed on explosion 3600°C; volume of gases at NTP 603 liters/kg; specific pressure 9600 kg/sq cm; velocity of detonation 6350 meters/second; Trauzl test value 385 cc; and impact sensitivity with a 2-kg weight 10 cm.

Dynamit (cont'd)

Dynamit 3. Nitroglycerin 34-39%, Collodion Cotton 0.5-3%, Ammonium Nitrate (or sodium or potassium nitrate) 45-54%, Nitrocompounds 6-10% & vegetable meal 1-6%.

Dynamit 5. Nitroglycerin 16-22%, Collodion Cotton 0.5-2%, Ammonium Nitrate 50-74%, Nitrocompounds 2-12%, vegetable meal 1-6% & sodium chloride (salt) 0-12%.

A current Dynamite, called Dynamit N, suitable for use in the demolition of reinforced concrete & steel construction, consists of RDX 70% & Nitroglycol (gelatinized) 30%. Its properties are reported as follows: Density in cartridge 1.54 gm/cc; temperature developed on explosion 4170°C; volume of gases, on explosion, at NTP 746 liters/kg; specific pressure 12538 kg/sq cm; and velocity of detonation 8200 meters/second.

See also Albit, Aldorfit, Alkalsit, Ammoncarbonit, Ammondynamit, Ammongelatine, Ammonit, Astralit, Berclavit B, Bikarbit, Cahücit, Calcinit, Carbonit, Cheddit, Chloratit, Donarit, Extracarbonit, Fordit, Fulmenit, Gesteinsprengstoffe, Nitrobaronit, Nobelit, Romperit 1, and others.

Energit or Triwestfalit SN — ENERGIT

This was originally a class of commercial explosives, prepared by wet grinding various kinds of surplus double-base Propellants to a particle size of 0.5-2.0 mm, followed by drying & packing into cartridges 25-30 mm in diameter. This explosive was used to a great extent in potash mining. It was manufactured after WW I by Nobel Dynamit AG.

Later industrial explosives, called Triwestfalit, were prepared by blending surplus WW II single-base Propellants, previously wetted with a solvent (such as furfurol or acetone), with liquid aromatic nitrocompounds & oxidizing agents (such as alkali nitrates or chlorates). The strength of this class of explosives as determined by the Trauzl test was 330-350 cc, and the velocity of detonation was between 3000-5000 meters/second.

Ersatzsprengstoffe — SUBSTITUTE EXPLOSIVES

Due to the acute shortage in Germany of TNT & other aromatic nitrocompounds, a number of substitute explosive mixtures were developed & used during WW II. Many of these substitute explosives were developed & manufactured at the Krümmel Fabrik of Dynamit A-G or its Christianstadt subsidiary.

From mid-1944, the following trends in the preparation of melt-loaded military explosives were noted:

a) substitution of RDX for part TNT in Amatol;

b) substitution of Dinitrobenzene for TNT in Amatol;

c) substitution of other nitroaromatic compounds such as Dinitrodiphenylamine, Hexanitrodiphenylamine, Trinitroxylene & Dinitronaphthalene for TNT in various compositions;

d) use of low-melting hydrous inorganic nitrates, such as calcium, potassium & sodium nitrates, to reduce or replace TNT;

e) use of aluminum powder in explosives;

f) use of miscellaneous organic ingredients such as urea, pentaerythritol, Guanidine Nitrate, Ethylenediamine Dinitrate & methylamine nitrate;

g) use of sodium chloride (up to 60%) or of so-called Scheidemehl (a mixture of calcium & magnesium silicates) in order to reduce the amount of TNT required. Most of the explosive compositions containing these substitute materials were less powerful & less brisant than TNT alone, thus lowering the efficiency of the ammunition.

As examples of Ersatzsprengstoffe or German substitute explosives, the following which are described separately may be listed: Amatol, Ammonal, Ammonit, C6, Cheddit, DI-Salz, Formit; Füllpulver Nrs: 13, 13a, 13-113, 19, 20, 52, 56, 57 (or Abonachit 2), 60, 61, 64, 70, 84 & 88; Hexamit, Hexa Sprengstoffe, KMA Ladung, Man-Salz, Myrol, Nitrolit, PH-Salz, R-Salz, Schiesswolle 18 or TSMV1-101, Tetan, Trialen, and others.

E-Salz — RDX

One of several German names for RDX depending upon its method of manufacture. E-Salz is prepared from formaldehyde, Ammonium Nitrate & acetic anhydride. See Hexogen.

Extracarbonit

CARBONIT
DYNAMITE

A permissible Dynamite used after WW I consists of Nitroglycerin 35%, Collodion Cotton 0.3%, potassium nitrate 25.5%, barium nitrate 4%, tan meal 34.7% & sodium carbonate 0.5%. Its density is 1.20 gm/cc and velocity of detonation 4070 meters/second.

See also Carbonit.

Feuerwerkerei & Pyrotechnik

PYROTECHNICS

Prior to & during WW II, the Germans developed & used a wide variety of Pyrotechnic Devices & Pyrotechnic Compositions. Their history, development & uses are found in many sources, but the most comprehensive coverage of this subject is reported by B.T. Fedoroff et al ["German Explosives, Propellants, Ammunition and Related Items", Picatinny Arsenal Technical Report 2510 (1958)].

Some of the numerous compositions & devices used include:

Brandstoffe or Brandsätze & Brandbomben (Incendiary Compositions & Incendiary Bombs). See Brandstoffe.

Leuchtkugeln or Fackeln (Flares). They consisted of the conventional cylindrical container housing the illuminating charge in single or multiple candle units. Flares were ignited by a pull-friction igniter or a time fuze; they burned vigorously to produce light which varied in intensity & color; they were made with & without parachutes; and were designed to be either dropped from planes or fired as projectiles from guns. Some of the different colored light compositions used are reported as follows:

Red Light - strontium nitrate 56%, magnesium 16%, Iglit (polyvinyl plastic binder) 21 & IG Farben wax (synthetic) 7%.

Green Light - barium nitrate 56%, magnesium 16%, Igelit 21% & IG Farben wax 7%.

Yellow Light - barium nitrate 61.5%, magnesium 15%, cryolite (mineral of sodium-aluminum fluoride) 8.5%, Igelit 6%, calcium oxalate 5% & IG Farben wax 4%.

White Light - barium nitrate 59%, potassium nitrate 21%, magnesium 11%, Igelit 3% & IG Farben wax 6%.

Feuerwerkerei (cont'd)

These compositions were used in the Mk 50 Kaskade Bombe.

A flare composition used in the ground glare, "Bodenleuchte", consisted of sodium nitrate 11.3%, gypsum (hydrated calcium sulfate) 45.5%, magnesium 34.6% & water 8.6%.

Leuchtsätze & Leuchtbomben (Illuminating Compositions & Illuminating Bombs). In addition to the compositions used above, the Germans employed rocket & bomb compositions in Antipathfinder Pyrotechnic Devices. These devices were intended to confuse the raiders by false signals which closely resembled those used by the Pathfinders. The compositions used produced red, green, yellow & white lights; or were employed in stars of various colors which were ejected by flares. The compositions of stars were somewhat different from those of flares. Some cartridges also contained smoke compositions (Rauchsätze) described separately.

Pfeifpatronen (Whistling Cartridges). This device contained two compositions:

a) Barium nitrate 55.5%, aluminum powder 35.5% & sulfur 9%, intended to produce light.

b) Potassium Chlorate 66.5% & gallic acid 33.5%; intended to produce a whistling sound. The cartridge was designed to be used as a signalling device or warning of enemy attack.

Rauchsätze (Smoke Compositions). These compositions may be subdivided into two types:

a) Those which on heating developed a dense white or black smoke to serve for screening purposes (Neblstoffe) and

b) those which on heating developed various colored smokes (Buntrauche).

Some examples of the smoke compositions are the following:

Black Smoke - hexachloroethane 61.5%, magnesium 18.5%, anthracene 8% & naphthalene 12%. The igniter train consisted of Black Powder and an Ignition Composition of potassium nitrate 24.0%, hexachloroethane 24.6%, Tetranitrocarbazole 18%, anthracene 5.6%, naphthalene 2.4%, aluminum 18% & magnesium 7.4%.

Feuerwerkerei (cont'd)

White Smoke - a. hexachloroethane 40%, zinc dust 50% & barium nitrate 10%; b. oleum (fuming sulfuric acid) 80% & pumice 20%; c. titanium tetrachloride & water in which calcium chloride was dissolved to prevent freezing.

Red Smoke - Potassium Chlorate 17%, lactose 24% & o-methoxy-phenylazo-beta-naphthol 59%.

Blue Smoke - Potassium Chlorate 30%, lactose 20% & 1-methylamino-4-p-toluidinoanthraquinone 50%.

Green Smoke - Potassium Chlorate 30%, lactose 24%, 9, 10-dianilinoanthracene 30% & 1-methylamino-4-p-toluidinoanthraquinone 16%.

Yellow-Orange Smoke - hexachloroethane 48%, iron oxide (Fe_2O_3) 36% & magnesium 16%.

Violet Smoke - Potassium Chlorate 25%, lactose 50%, 1-methylamino-4-p-toluidinoanthraquinone 15% & Rhodamine B 10%.

Signalmitteln (Signal Devices). These devices include a variety of Pyrotechnic items: Hand Smoke Signal (Handrauchzeichen), Signal Cartridge (Signalpatrone), Signal Flare (Signalbombe), Signal Hand Grenade (Signalhandgranate), Signal Pistol (Leuchtpistole or Kampfpistole), Signal Projector (Signalwerfer), Signal Rocket (Signalrakete) & Signal Torch (Signalfakel). The compositions employed in these devices, their igniters or intermediate compositions may be those described above or modifications thereof.

Fackeln or Leuchtkugeln (Flares) — PYROTECHNICS

See Feuerwerkerei.

Flammbomben (Incendiary Bombs) — INCENDIARY COMPOSITIONS

See under Brandstoffe or Brandsätze & Brandbomben for Incendiary Bomb compositions.

Födit — FÖRDIT, GELATIN DYNAMITE

Födits are permissible Gelatin Dynamites manufactured & used between WW I & WW II. Their compositions are as follows:

Fördit (cont'd)

Fördit - Ammonium Nitrate 41%, Nitroglycerin 23%, Collodion Cotton 1%, glycerin 8.7%, mononitrotoluene 3.5%, potassium chloride 22%, China clay 0.1% & dextrin 0.7%.

Fördit 1 - Ammonium Nitrate 37%, Nitroglycerin 25.5%, Collodion Cotton 1.5%, glycerin 3%, mononitrotoluene 5%, potassium chloride 24% & dextrin 4%.

Fördit 4 - Ammonium Nitrate 38%, Nitroglycerin 21%, Collodion Cotton 1%, glycerin 3%, mononitrotoluene 5%, flour 12%, potassium chloride 19% & ammonium oxalate 1%. Its oxygen balance is -19.5% & Trauzl test value 220 cc.

Formit — FORMIT

One of the German substitute explosives developed during WW II by Dr. Hans Walter et al. It is obtained by heating a mixture of 3% commercial formaldehyde & Ammonium Nitrate (ratio 6/8) under reflux for one hour, followed by vacuum distillation to remove water & unreacted formaldehyde. The product, a faintly yellow composition, consists of Man-Salz (Methylamine Nitrate) 25%, Tri-Salz (Trimethylammonium Nitrate) 1-3% & Ammonium Nitrate 67-74%.

Its calorific value is 900 cal/gm & volume of gases produced on explosion 1050 liters/kg (calculated at 0°C & 760 mm pressure). When 15% of RDX or PETN is incorporated with Formit, the velocity of detonation is significantly increased and the brisance is increased to that of TNT, while the volume of gases are higher than for TNT. Formit can be cast loaded (setting point 90°C) into projectiles but it exudes at 60-70°C. It is fairly stable to heat provided no iron impurities are present.

See also C6.

Füllpulver (Fp) or Füllung — EXPLOSIVE FILLER

German explosive fillers or bursting charges are often designated Füllpulver or Fp with a number suffixed to indicate a specific explosive or explosive mixture. The principal fillers known by designation are as follows:

Füllpulver Nr 1 (Fp 02). TNT, pressed in carboard or metal tubes, was used in Shells, Depth Charges, Land Mines & Demolition Charges.

Füllpulver (Fp) or Füllung (cont'd) EXPLOSIVE FILLER

Füllpulver Nr 2 or Granatfüllung 88. Picric Acid, pressed in cardboard or metal containers, was used in Shells, Land Mines, Depth Charges & Demolition Charges.

Füllpulver Nr 3 or Nitropenta (Np). PETN, pressed, was used as the Detonator and as a filler for Grenades & small caliber Shells.

Füllpulver Nr 4 (Fp 02). TNT, loose in paper containers, was used in Grenades.

Füllpulver Nr 5. Picric Acid, granular, was used as a bursting charge in Hand Grenades.

Füllpulver Nr 6. 95/5 TNT/wax, in blocks, was used in cardboard containers.

Füllpulver Nr 7 (Fp 02). TNT, pressed, was used for loading Shells, auxiliary Boosters, Bombs (over 50-pounds) & chemical ammunition.

Füllpulver Nr 8 (Fp 02). TNT, cast, was used as bursting charge in high-explosive Shells.

Füllpulver Nr 10. Consists of TNT, TNT + 5% wax & TNT + 10% wax, pressed. It was used in Armor-Piercing Shells.

Füllpulver Nr 11. Consists of TNT, TNT + 10% wax, TNT + 15% wax & TNT + 20% wax, pressed. It was used in Armor-Piercing Shells.

Füllpulver Nr 12. Consists of TNT, TNT + 5% wax & RDX + 10% wax, pressed in cardboard containers. It was used in Armor-Piercing Shells.

Füllpulver Nr 13 (Fp 60/40). Consists of TNT 60% & Ammonium Nitrate 40%. It corresponds to US 40/60 Amatol. See under Amatol.

Füllpulver Nr 13a (Fp 50/50). Consists of TNT 50% & Ammonium Nitrate 50%. It corresponds to US 50/50 Amatol. See under Amatol.

Füllpulver (Fp) or Füllung (cont'd)

Füllpulver Nr 13-113. Consists of Ammonium Nitrate 70%, TNT 20% & aluminum 10%. It corresponds to US Ammonal. See under Ammonal.

Füllpulver Nr 14 (Fp 02). TNT, cast, was used as filler in General-Purpose, Semi-Armor-Piercing, Armor-Piercing & Antipersonnel Bombs.

Füllpulver Nr 15. TNT 90% & aluminum 10%, cast, was used as bursting charge in mountain artillery Shells.

Füllpulver Nr 16. TNT, cast in aluminum container, plus PETN & 10% wax as an exploder, was used as bursting charge in Shells, and as a core charge in submarine Mines.

Füllpulver Nr 17. Consists of TNT 90% & aluminum 10%, cast, plus PETN + 10% wax as an exploder. Its uses were not specified.

Füllpulver Nr 17a. Consists of a matrix of 54/32/14 Dinitroanisole/Ammonium Nitrate/RDX and a biscuit of 46/21/20/9/4 Ammonium Nitrate/calcium nitrate/RDX/PETN/hydrated water.

Füllpulver Nr 18. Consists of TNT 80%, RDX 19% & Montan wax 1%. It was used as a cast bursting charge in Shells.

Füllpulver Nr 19. Consists of TNT 55%, Ammonium Nitrate 35% & aluminum 10%. See under Ammonal.

Füllpulver Nr 20. Consists of Ammonium Nitrate 53.5%, Ethylenediamine Dinitrate 45% & aluminum 1.5%. Its use in ammunition is not reported.

Füllpulver Nr 21. Ammonium Nitrate 60% & TNT 40% with a core of pressed TNT pellets.

Füllpulver Nr ?. Ammonium Nitrate 50%, TNT 35% & Dinitronaphthalene 15%. This mixture was used as an extender for TNT in ammunition.

Füllpulver Nr 24. Cast Picric Acid. It was used as a bursting charge in Shells, as a standard burster, and as a Sub-Booster in gaines when Mercury Fulminate was the initiator.

Füllpulver (Fp) or Füllung (cont'd)

Füllpulver Nr 27. Consists of TNT & TNT + 10% wax, pressed. It was used in Armor-Piercing Shells & Semi-Armor-Piercing Bombs.

Füllpulver Nr 28. Consists of 90/10 TNT/wax + 90/10 PETN/wax, pressed in blocks & in aluminum containers. It was used in High-Explosive & Armor-Piercing Shells.

Füllpulver Nr 29. Consists of the following charges, each individually pressed as layers in Shells:

a. TNT + 10% wax
b. TNT (crystalline)
c. 70/30 (TNT + 10% wax)/potassium chloride
d. 50/50 (TNT + 10% wax)/potassium chloride

Another source reports this composition as the above charges pressed in blocks & in cardboard containers.

Füllpulver Nr 30. Consists of TNT & TNT + 5% wax, pressed in Shells.

Füllpulver Nr 32. 90/10 PETN/wax, pressed in wax paper. It was used in Antitank Mines, and as a standard Sub-Booster in all types of ammunition.

Füllpulver Nr 33. 85/15 PETN/wax, pressed in wax paper. It was used in Antitank Mines, and as a standard Sub-Booster in all types of ammunition.

Füllpulver Nr 34. 70/30 PETN/wax, pressed, was used as a bursting charge in special Shells.

Füllpulver Nr 36. 60/40 PETN/wax, pressed, was used as a bursting charge in special Shells.

Füllpulver Nr 37. 50/50 PETN/wax, pressed, was used as above.

Füllpulver Nr 38. 35/65 PETN/wax, pressed, was used as above.

Füllpulver Nr ? . 91.5/8.5 PETN/wax, pressed, was used as a Sub-Booster in Bomb gaines, in 80 mm Chemical Mortar Shells, and in 37 mm & 50 mm Shells.

Füllpulver Nr ?. 82/18 PETN/wax, pressed, was used in 37 mm Armor-Piercing Round Nose Shell, and Armor-Piercing Monoblock Shells.

Füllpulver (Fp) or Füllung

Füllpulver Nr ?. 87/13 PETN/wax, pressed, was used in 88 mm High-Explosive Shells.

Füllpulver Nr ?. 92/8 PETN/wax, pressed, was used in Antitank Mk 1 50 mm Trench Mortar Shells, in 105 mm HE Howitzer, as a detonator surround in 50 mm & 75 mm HE Shells, and in some 75 mm & 88 mm Armor-Piercing Shells.

Füllpulver Nr 42. Consists of 50/50 PETN/TNT (called Pentol in Germany) + 10% wax, pressed. It was used in High-Explosive Shells.

Füllpulver Nr 43. A plastic explosive, consisting of PETN & mineral oil, was used in some High-Explosive Shells.

Füllpulver Nr 45. Consists of 50/50 PETN/RDX + 30% wax. It is similar in properties to 70/30 PETN/wax (Füllpulver Nr 34) and was used as a bursting charge in special Projectiles. Another mixture by the same name consisted of RDX 50%, PETN 35% & wax 15%.

Füllpulver Nr 52. A castable yellow composition consisting of Dinitrobenzene 50%, Ammonium Nitrate 35% & RDX 15%. Its properties are similar to those of 50/50 Amatol, except this mixture is toxic due to the presence of Dinitrobenzene. It was used in 50 kg General Purpose & Semi-Armor-Piercing Bombs. The composition of this filler is also reported as a matrix of 47/38/15 Dinitrobenzene/Ammonium Nitrate/RDX with a biscuit of 46/21/20/9/4 Ammonium Nitrate/calcium nitrate/RDX/PETN/hydrated water.

Füllpulver Nr 52a. A pressed explosive composition consisting of Ammonium Nitrate 55%, calcium nitrate 30% & RDX 15%. It is less powerful & brisant but about the same sensitivity as 50/50 Amatol (Füllpulver Nr 13a). It was used as a biscuit filling in the nose of parachute & robot Bombs, with a surround of Füllpulver Nr 52. The composition of this filler is also reported as a matrix of either 50/35/15 or 53/30/17 of Dinitrobenzene/Ammonium Nitrate/RDX with a biscuit filling of 46/21/20/9/4 Ammonium Nitrate/calcium nitrate/RDX/PETN/hydrated water.

Füllpulver (Fp) or Füllung (cont'd)

Füllpulver Nr 56. A Donarit explosive consisting of Ammonium Nitrate 67-80%, TNT 12-25%, Nitroglycerin 3.8%, Collodion Cotton 0.2% & vegetable meal 4%. It is a yellow, semi-plastic mixture possessing nearly the same explosive properties of 80/20 Amatol, except that it is slightly more sensitive as shown by impact & rifle bullet tests. It was used as a filler for Hand Grenades. The composition of this filling is also reported as Ammonium Nitrate 80%, TNT 12%, Nitroglycerin 4% & rye flour 4%.

Füllpulver Nr 57 or Abonachit 2. This mixture consisted of Ammonium Nitrate 64%, potassium or sodium nitrate 3%, Trinitroxylene 13%, Collodion Cotton 1% & Sodium Chlorate 19%. It was used as a bursting charge in some Grenades. Another source reports this composition as Ammonium Nitrate 64%, potassium or sodium nitrate 3%, Trinitroxylene 14%, Collodion Cotton 1%, charcoal 1% & sodium chloride 17%. This latter composition is known as Monachit 2.

Füllpulver Nr ?. A castable composition consisting of Ammonium Nitrate 55%, Ethylenediamine Dinitrate 30%, technical grade calcium nitrate 5%, RDX 8% & wax 2%. Its explosive properties are similar to 50/50 Amatol (Fullpulver Nr 13a). It was used as a bursting charge in some ammunition.

Füllpulver Nr 60. Pressed Trinitrochlorobenzene used as a bursting charge in Shells.

Füllpulver Nr 61. Cast Trinitrochlorobenzene used as above.

Füllpulver Nr 64. A castable white to brownish mixture of Trinitrochlorobenzene 60% & Ammonium Nitrate 40%. Its explosive properties are similar to those of 40/60 Amatol (Füllpulver Nr 13), except that it is hygroscopic, unstable & very toxic. It was used as a bursting charge in Shells.

Füllpulver Nr 66. A pressed 50/50 PETN/wax mixture.

Füllpulver Nr 70. Pressed Trinitrobenzene. It was used in some Primers.

Füllpulver Nr 83. A mixture of Ethylenediamine Dinitrate with some other high explosive to permit cast loading.

Füllpulver (Fp) or Füllung (cont'd)

Füllpulver Nr 84. A mixture of Ethylenediamine Dinitrate 55% & Ammonium Nitrate 45%. It was used as a bursting charge in Shells.

Füllpulver Nr 86. A mixture of Ethylenediamine Dinitrate 46%, RDX 18% & wax 36% pressed in blocks, wrapped in wax paper and placed in aluminum containers.

Füllpulver Nr ? (Fp 30/70). See under Amatol.

Füllpulver Nr ? (Fp 5/95). See under Amatol.

Füllpulver Nr 88 (Fp 40/60). See under Amatol.

Füllpulver Nr 89. A general name for castable mixtures based on RDX.

Füllpulver Nr 90. A general name for pressed mixtures based on RDX.

Füllpulver Nr 91-H5. A mixture of RDX 95% & Montan wax 5%, pressed, was used in Sub-Boosters & Boosters.

Füllpulver Nr 92-H10. A mixture of RDX 90% & Montan wax 10%, pressed, was used in Boosters.

Füllpulver Nr ?-H10.3. A mixture of RDX 89.7% & Montan wax 10.3%, pressed, was used as a bursting charge in 75 mm Armor-Piercing Shells.

Füllpulver Nr ?-H3. A mixture of RDX 97% & Montan wax 3%, pressed, was used in Booster for tropical countries, to replace PETN/wax mixtures.

Füllpulver Nr 95 (H/Fp 02). A mixture of RDX 60% & TNT 40%, pressed, was used as a bursting charge in some Shells. This composition is the same as US 60/40 Cyclotol which is cast.

Füllpulver Nr 101 (Fp 15). A composition of TNT 85% & wax 15%, pressed, was used as a bursting charge in Armor-Piercing Bombs. This filler is reported also as TNT 92% & wax 8%.

Füllpulver Nr 102. A composition consisting of Ammonium Nitrate 60%, TNT 40% & wax (amount not specified). Its uses are not given.

Füllpulver (Fp) or Füllung (cont'd)

Füllpulver Nr 104. RDX. Its uses are not specified.

Füllpulver Nr 105 (Trialen 105). A composition consisting of TNT 70%, RDX 15% & aluminum 15%. It was cast loaded into General-Purpose Bombs & Torpedoes. Another mixture by the same name consisted of TNT 74%, naphthalene 14% & aluminum 12%.

Füllpulver Nr 106 (Trialen 106). A mixture consisting of TNT 50%, RDX 25% & aluminum 25%, cast, was used as a bursting charge in Bombs.

Füllpulver Nr 107 (Trialen 107). A castable composition consisting of TNT 50%, RDX 20% & aluminum 30%. It was used as the filler for underwater ammunition.

Füllpulver Nr 108 (?) (Tritolital). A castable composition consisting of TNT 60%, RDX 20% & aluminum 20%. It was used as the bursting charge for underwater ammunition.

Füllpulver Nr 109 (Trialen 109). A pressed mixture of RDX 70%, aluminum 25% & Montan wax 5% was used as a biscuit filling, with a Nitroguanidine nose charge, and with a surround of Fullpulver Nr 106 (Trialen 106) in the 500-kg General-Purpose & 1800-kg Armor-Piercing Bombs. This combination charge was also used in Pilotless Aircraft Missiles. This filler is more sensitive than RDX alone, and cannot be used without the protective nose charge of Nitroguanidine.

Füllpulver Nr 110. A press-loaded composition consisting of Ammonium Nitrate 90%, naphthalene 5%, wood meal 2.5% & aluminum 2.5%. It requires a secondary HE booster to detonate the charge. It was used in Anticoncrete & Anti-Personnel Bombs. See also under Ammonal.

Füllpulver Nr 111. A mixture of Ammonium Nitrate 90%, carbon 6% & mineral matter 4%. It was used as a press-loaded bursting charge in some Bombs. The composition is also reported as Ammonium Nitrate 96% & carbon 4%.

Füllpulver Nr 112. A mixture of Ammonium Nitrate 80% & TNT 20%, pressed or cast, was used as the bursting charge in some Bombs. This composition corresponds to US 80/20 Amatol.

Fulmenit

FULMENIT
AMMONIUM NITRATE DYNAMITE

A Favier-type Dynamite consisting of a) Ammonium Nitrate 86.5%, TNT 5.5%, Guncotton 4%, paraffin oil 2.5% & charcoal 1.5% and b) Ammonium Nitrate 82.5%, TNT 11%, Guncotton 4%, paraffin oil 1% & charcoal 1.5%.

Gelatinedynamit

GELATIN DYNAMITE

This class of commercial & industrial Dynamites includes such types as "Ordinary & Low-Freezing", "Safe to Transport" & "Permissible" Dynamites. Due to the shortage of aromatic nitrocompounds during WW II, the Germans used some Dynamites as Demolition Charges & as bursting charges in Hand Grenades.

The following list illustrates the variety of Gelatin Dynamites used:

Gelatine-Astralit. A plastic low-freezing composition consisting of Nitroglycerin 30%, Dinitrotoluene/TNT 10% & Ammonium Nitrate/sodium nitrate/wood meal 60%. Its velocity of detonation is 7300 meters/second.

Gelatine-Carbonit D. A permissible Dynamite consisting of Ammonium Nitrate 31.5%, potassium nitrate 5.1%, Nitroglycerin (+ Collodion Cotton) 30%, glycerin (+ gelatin) 2.5% & sodium chloride (salt) 30.9%. Its oxygen balance is +5.3% & Trauzl test value 225 cc.

Gelatine-Cheddit. A gelatinous chlorate explosive such as Sodium Chlorate 70% & Collodion Cotton (gelatinized with liquid TNT) 30%.

Gelatine-Donarit. A gelatinous industrial explosive consisting of Ammonium Nitrate 50%, Dinitrochlorohydrin/Nitroglycol 30% & combustible fuels 20%. At a cartridge density of 1.45 gm/cc, its velocity of detonation is 6250 meters/second.

Gelatine-Prosperit. A low-freezing gelatinous explosive consisting of Ammonium Nitrate 36%, sodium nitrate 4%, Dinitrochlorohydrin 20%, Nitroglycerin 5%, Nitrocellulose 0.5%, Dinitrotoluene 5%, cereal meal 2.5%, potassium oxalate 6% & sodium chloride (salt) 21%. Its oxygen balance is + 0.4% & Trauzl test value 225 cc.

Gelatinedynamit (cont'd)

Gelatin-Romperit. Same as Gelatine-Donarit.

Gelatine-Tremonit. Low-freezing gelatinous explosives consisting of: a. Ammonium Nitrate 22.5%, sodium nitrate 20%, gelatinized Di- & Tri-nitroglycerin 47.5%, Dinitrotoluene 5% & wood meal 5%. Its Trauzl test value is 400 cc., and b. Ammonium Nitrate 40%, sodium nitrate 18%, gelatinized Di- & Trinitroglycerin 30%, Dinitrotoluene 10% & wood meal 2%. Its Trauzl test value is 375 cc.

Gelatine-Wetter-Nobelit. A permissible explosive suitable for use in gaseous coal mines. Its composition is: Gelatinized Nitroglycerin 30%, Ammonium Nitrate 26.5%, wood meal 0.5%, sodium chloride (salt) 40% & calcium nitrate (50% aqueous solution) 3%.

Gelbmehl (Yellow Flour) — TETRANITROCARBAZOLE

See Tetranitrocarbazol.

Gesteinssprengstoffe (Rockblasting Explosives) — BLASTING EXPLOSIVES, DYNAMITE

These are Blasting Explosives suitable for blasting rocks, ores, construction etc, but not for use in gaseous coal mines. The following are the more important types used:

Gesteins-Albit. See under Albit.

Gesteins-Dorfit. Ammonium Nitrate 65%, TNT 15%, potassium nitrate 5%, rye flour 5% & sodium chloride (salt) 10%. At a density of 1.17 gm/cc, its velocity of detonation is 4605 meters/second in a 50-mm-diameter confined charge.

Gesteins-Koronit. See under Chloratit.

Gesteins-Persalit 2. Ammonium Nitrate 48%, Potassium Perchlorate 34%, Dinitrotoluene 10%, carbon 2% & wood meal 6%. Its oxygen balance is +1.7% & Trauzl test value 325 cc.

Gesteins-Westfalit. Ammonium Nitrate 84.5%, Dinitrotoluene 12.0% & aluminum 3.5%.

Granatfüllung 88 — PICRIC ACID

See Füllpulver Nr 2 under Füllpulver.

G-Salz — NITROGUANIDINE

Guhrdynamit — DYNAMITE

Hellhoffit — HELLHOFFIT

A Sprengel-type explosive invented about 1870 by Hellhof & Grüson. It consisted of Nitrobenzene 28% & fuming nitric acid 72%. It was sometimes used absorbed on kieselguhr. At one time it was tried in Shells, the two ingredients being mixed during flight and exploded on impact.

It was found during WW II that Hellhoffit & its modifications in glass-lined Depth Charges are more effective than Picric Acid. The mixture consisting of Nitrobenzene 25.8%, fuming nitric acid (density 1.52 gm/cc) 64.5%, carbon disulfide 6.5% & aluminum bronze 3.2% was found most effective.

Hexa, Hexamin, Hexanitrodiphenlyamin or Hexyl — HEXANITRODIPHENYLAMINE

Hexanitrodiphenylamine has been used in German underwater explosive charges since WW I. The original explosive of TNT 60% & Hexanitrodiphenylamine 40% was replaced, during WW II, with one consisting of TNT 60%, Hexanitrodiphenylamine 24% & aluminum 16%. This mixture is known as Schiesswolle 18 or TSMVI-101.

See also Hexa S-22, S-26, E-4; Hexamit, KMA Ladung & Neorodit.

Hexal — HEXAL

An explosive mixture consisting of RDX (coated with 5% wax) 75% & aluminum 25%. This composition was used press loaded in underwater ammunition.

Hexamin HEXANITRODIPHENYLAMINE

See Hexa.

Hexamit or Hexanit HEXAMIT

This name is applied to explosive mixtures consisting of TNT/Hexanitrodiphenylamine in various proportions 60/40, 50/50 & 40/60. It was used during WW I & WW II as a castable bursting charge in underwater ammunition.

The proportions were modified during WW II, to include aluminum, in a composition known as Schiesswolle 18 or TSMV1-101. Surplus Hexamit was also used in a commercial explosive called Neorodit.

Hexamit was also used by the Japanese under the names Seigata (Army) & Type 97H (Navy), and by Sweden under the name Novit.

Hexanitrodiphenylamin HEXANITRODIPHENYLAMINE

See Hexa.

Hexa Sprengstoffe HEXA SPRENGSTOFFE

Some German Substitute Explosives (Ersatzsprengstoffe) containing Hexanitrodiphenylamine were designated during WW II as follows:

Hexa S-22. Ammonium Nitrate 45%, sodium nitrate 9%, potassium nitrate 3%, Ethylenediamine Dinitrate 14%, aluminum powder 15% & Hexanitrodiphenylamine 14%. This mixture sometimes exploded during the loading of Projectiles.

Hexa S-26. Ammonium Nitrate 55%, sodium nitrate 9%, potassium nitrate 4.2%, urea 1.8%, aluminum 15% & Hexanitrodiphenylamine 15%.

Hexa E-4. Ammonium Nitrate 44%, sodium nitrate 10%, urea 2%, aluminum 30% & Hexanitrodiphenylamine 14%.

All of the above compositions were used in military applications.

See also Unterwassersprengstoffe.

Hexogen RDX

This compound is also called E-Salz, K-Salz, KA-Salz, SH-Salz & W-Salz, depending upon its method of manufacture. Although RDX was known in Germany since 1899 (Henning, German Patent 104280), it was not used in Germany until 1935 when its manufacture was started using the W-Verfahren (W-Process) listed below. Four other methods of manufacturing RDX were later introduced. Production reached its peak in June 1944 when almost 8 million pounds were manufactured during the month. The KA-Verfahren proved to be the best process because it was most economical, required less space & equipment, and used readily available materials.

The German WW II methods of manufacturing RDX, in approximate chronological order, are as follows:

W-Verfahren (W-Process). Developed in 1935 by Dr. Wolfram of IG Farbenindustrie, this process is based upon the following reactions:

a) Sulfur trioxide & ammonia to yield ammonium aminosulfonate & ammonium iminosulfonate.

b) Product from a) is treated with a solution of calcium hydroxide to give soluble calcium aminosulfonate & a precipitate of calcium sulfate.

c) Liberated ammonia from b) is used in reaction a; calcium sulfate is removed by filtration; and the calcium aminosulfonate is treated with potassium sulfate.

d) The resulting potassium aminosulfonate is separated & treated with formaldehyde at 30°C.

e) The condensation product, potassium methyleneaminosulfonate, is nitrated with mixed nitric-sulfuric acid at 30°C.

This process gave yields up to 80% based on the formaldehyde used.

E-Verfahren (E-Process). This process, developed during 1935-38 by Drs. Eberle & Fischer, is based on the reaction of paraformaldehyde with Ammonium Nitrate, dissolved in acetic anhydride. The resulting RDX is separated, washed with water, stabilized & dried. The product has a melting point of only 190-195°C, and is obtained

in yields of 60-75% based on paraformaldehyde. It contains the same impurities, but in larger amounts, as found in the KA-Verfahren.

SH-Verfahren (SH-Process). Dr. Schnurr developed this process, in 1937-38, based on the original method of Henning of 1899. It involves direct nitration(at -5°C) of hexamethylenetetramine (also called hexamine & urotropine) with absolute nitric acid (99%). The improvement introduced by Dr. Schnurr consists of the contents of the nitrator after reaction is completed. The unstable products formed during the reaction are thereby partly decomposed & partly nitrated to RDX. The purified product (yield 72%) has a melting point of 200-202°C. This process is considered to be more economical then the W-, E-, & K-Processes, but inferior to the KA-Process.

K-Verfahren (K-Process). This process was developed by Dr. Knöffler of Westfälisch-Anhaltische Sprengstoff Aktiengesellschaft, somewhat later than the E-Verfahren (after 1938). It is based on the fact that the deficiency of two NA_2 groups in the hexamine molecule ($C_6H_{12}N_4$) which are required for the production of each two moles of RDX can be remedied by introducing into the reaction two moles of Ammonium Nitrate. The reactants are therefore 1 mole of hexamethylenetetramine, 4 moles of 99% nitric acid & 2 moles of Ammonium Nitrate to produce 2 moles of RDX.

KA-Verfahren (KA-Process). This process also developed by Dr. Knöffler is actually a combination of parts of the K- & E-Processes. It involves treating hexamethylenetetramine dinitrate with acid Ammonium Nitrate in acetic anhydride. The resulting product is separated from acetic acid, washed with water & dried. It contains as impurities 1-2% of HMX & a small amount of a cyclotrimethylene derivative. The RDX obtained by this method (yield 80-82%) is called KA-Salz.

Straight RDX was used as a booster, sub-booster, and as a bursting charge in rifle Grenades & small-caliber Shells. It was also used with a small amount of wax (3%) to replace PETN-wax as a sub-booster. With larger amounts of wax (10%), RDX was used as a bursting charge in 75-mm Shells. It was also used with other proportions of wax, with TNT, with aluminum, and with other ingredients as main charges in various military ammunition.

Some composite military explosives using RDX as an ingredient include: C6, Formit; Füllpulver Nrs: 17a, 18, 45, 52, 52a, (?), 86, 89, 90, 91-H5, 92-H10, ?-H10.3, ?-H3, 95, 104, 105, 106, 107, 108 (?), 109; Hexoplast 75, Plastit, R-Salz Sprengstoffe, Trialen, and others.

Hexolit — HEXOLIT

A Nipolit-type explosive consisting of Nitrocellulose-Diethyleneglycol Dinitrate-RDX, instead of the PETN used in Nipolit. It was developed during WW II to be used either as a Propellant or High Explosive. See Nipolit.

Hexoplast 75 — HEXOPLAST

A plastic explosive developed during WW II at the Krümmel Fabrik of Dynamit A-G. It consists of RDX 75%, Nitrocellulose 1.3%, liquid Dinitrotoluene 20% & TNT 3.7%. This explosive is manufactured by heating the RDX in a mixer and blending it with the Nitrocellulose. This is followed by the addition of the DNT/TNT mixture and further blending. This order of addition of the ingredients prevents any lumping of the mixture.

This explosive was press loaded into cylinders 28 mm in diameter & 220 mm long. Due to difficulty with direct cap initiation, a booster consisting of phlegmatized PETN pellets is required. Hexoplast was developed to replace the RDX/US vaseline plastic mixture because US vaseline was no longer available in Germany.

See also Plastit.

Hexyl — HEXANITRODIPHENYLAMINE

See Hexa.

Holtex — HOLTEX

See under Swiss Explosives.

Initialsprengstoffe & Zündhütchensätze — INITIATING EXPLOSIVES and PRIMING COMPOSITIONS

Some German Priming & Initiating compositions used during WW II in Fuzes, Detonators & Primers are as follows:

a) Potassium Chlorate 43%, Mercury Fulminate 23.5%, antimony trisulfide 23.5% & ground glass 10%.

b) Lead Styphnate 94% & Nitrocellulose (paste using amyl acetate) 6%.

Initialsprengstoffe & Zündhütchensätze (cont'd)

c) Lead Styphnate 88.7% & Nitrocellulose (paste using amyl acetate) 11.3%

d) Lead Styphnate 37.5%, barium nitrate 38.5%, calcium silicide 12.4%, antimony trisulfide 7.4% & Tetracene 4.2%

e) Lead Styphnate 49.1%, barium nitrate 35.5% & calcium silicide 15.4%

f) Lead Styphnate 52.1% & barium nitrate 47.9%

g) Lead Azide 82%, antimony trisulfide 7% & ground glass 11%

h) Lead Azide 60% & Lead Styphnate 40%

i) Lead Azide 55% & Lead Styphnate 45%

j) Lead Styphnate 85.6% & Lead Azide 14.4%.

Some additional WW II cartridge-case Primer Compositions include:

a) Potassium Chlorate 35%, antimony trisulfide 37%, Mercury Fulminate 21.5% & abrasive 6.5%

b) Potassium Chlorate 28.2%, antimony trisulfide 31.1%, Mercury Fulminate 25.7% & abrasive 15%

c) Potassium Chlorate 29.1%, antimony trisulfide 43.4%, Mercury Fulminate 16.7% & abrasive 10.8%

d) Lead Nitrate 53.6%, Lead Styphnate 19.2%, antimony trisulfide 6.1% & abrasive 21.1%

e) Lead Nitrate 50.1%, Lead Styphnate 26.4%, antimony trisulfide 18.2% & abrasive 5.3%.

Some additional WW II Primer Compositions used only in Fuzes include:

a) Potassium Chlorate 61%, antimony trisulfide 33% & abrasive 6%

b) Potassium Chlorate 58.5%, antimony trisulfide 27.5%, carbon 9.5% & abrasive 4.5%

Initialsprengstoffe & Zündhütchensätze (cont'd)

c) Potassium Chlorate 40%, Mercury Fulminate 29% & antimony trisulfide 31%

d) Potassium Chlorate 45%, Mercury Fulminate 12%, antimony trisulfide 34% & abrasive 9%

e) Potassium Chlorate 29.5%, antimony trisulfide 54.6%, carbon 10.7% & abrasive 5.2%

f) Lead Azide 65% & calcium silicide 35%, used over a charge of PETN

g) Potassium Chlorate 37%, Mercury Fulminate 26%, antimony trisulfide 30% & glass 7%

h) Potassium Chlorate 51%, antimony sulfide 24% & abrasive 25%

i) Potassium Chlorate 38%, Mercury Fulminate 14%, antimony trisulfide 42% & glass 6%

j) Lead Styphnate 41%, barium nitrate 41%, calcium silicide 15% & antimony trisulfide 3%.

See also AS-3 & Detonatoren- und Sprengkapseln-Ladungen.

KA-Salz — RDX

See Hexogen.

One of several German names for RDX depending upon its method of preparation. KA-Salz is prepared by the interaction of hexamine, Ammonium Nitrate, nitric acid & acetic anhydride.

KH Ladung — TNT

The designation for a compressed charge consisting of 4-8 pellets of TNT wrapped in paper & dipped in paraffin. These blocks were used as the bursting charge in Naval mines.

KMA Ladung — KMA LADUNG

One of the substitute explosives consisting of TNT 40%, Hexanitrodiphenylamine 30%, Dinitronaphthalene 20% & aluminum 10%.

Knallquecksilber — MERCURY FULMINATE

Mercury Fulminate was used to a limited extent in Detonators & in some Priming Compositions.

See Detonatoren- und Sprengkapseln- Ladungen and Initialsprengstoffe & Zündhütchensätze.

Kohlensgrengstoffe (Coal Explosives) — DYNAMITE

A group of explosives permitted for use in coal mines.

See Ammoncarbonit, Carbonit & Extracarbonit.

K-Salz — RDX

See Hexogen.

One of the German names for RDX depending upon its method of manufacture. K-Salz is prepared from hexamine, Ammonium Nitrate & nitric acid.

Leonit — LEONIT, CHEDDITE

A permissible explosive consisting of Potassium Perchlorate 35%, Ammonium Nitrate 10%, sodium nitrate 3%, Nitroglycerin 4%, crude TNT 11%, wood flour 7% & alkali chloride (salt) 30%.

Leuchtkugeln or Fackeln (Flares) — PYROTECHNICS

See Feuerwerkerei.

Leuchtsätze & Leuchtbomben (Illuminating Compositions & Illuminating Bombs) — PYROTECHNICS

See Feuerwerkerei.

Man-Salz — METHYLAMINE NITRATE

The German technical grade salt, made by nitrating methylamine with weak technical grade nitric acid (45-66%) at 70°C, has a melting point of 103°C; the purified material melts at 109-110°C.

Man-Salz (cont'd)

Its properties are reported as follows: Heat of explosion 1200 cal/gm (TNT value = 1000); volume of gases produced on explosion at NTP 834 liters/kg (TNT value = 780); and velocity of detonation 6600 meters/second (TNT value = 6200) at a density not indicated. This salt is practically insensitive to shock, and stable up to 150°C. Man-Salz is hygroscopic but this can be reduced by mixing it with other materials.

Due to the high melting point of Methylamine Nitrate, it is considered unsafe to cast load it into Shells & Bombs. This difficulty was overcome by incorporating some alkali nitrate. One such mixture developed during WW II is called Formit. A more satisfactory mixture consists of Methylamine Nitrate 50%, sodium nitrate 35% & RDX 15%.. This mixture is called C6.

Methyl Nitrate was also used in mining explosives where it was usually mixed with sodium nitrate, with which it forms a eutectic melting below 50°C, and a small amount of hydrated starch to render the mixture plastic.

Miedziankit — CHEDDITE, MIEDZIANKIT

See Chloratit 3 under Chloratit.

Monachit — MONACHIT

See Füllpulver Nr 57 under Füllpulver.

Myrol — MYROL

Myrol is a liquid explosive consisting of a solution of Methyl Nitrate in methanol or other solvent. This term is also used to designate straight Methyl Nitrate. During WW II Dr. H. Walter et al developed a continuous method of manufacturing Methyl Nitrate from methanol and dilute nitric acid. This method gave a purer & much more stable product than that prepared previously.

This compound is a more powerful explosive than Nitroglycerin, with a brisance exceeding that of any other high explosive known.

Myrol (cont'd)

Its sensitivity to shock is the same as that of PETN. Pure Methyl Nitrate is a clear, mobile liquid with a boiling point of 63°C. It is insoluble in water.

The most suitable solution of Myrol is the azeotropic mixture consisting of Methyl Nitrate 75% & methanol 25%. It has a boiling point of 57.5°C. Some other properties are: Velocity of detonation 7500-8200 meters/second; volume of gases 873 liters/kg; heat of explosion 1640-1700 cal/gm; power & brisance, similar to Nitroglycerin; sensitivity to shock, similar to Dinitrobenzene; and toxicity, similar to Nitroglycerin & PETN.

Liquid Myrol mixtures were used for military & commercial blasting operations, as a bursting charge in Bangalore Torpedoes, in mine field clearance, and as a Rocket fuel. A mixture of Methyl Nitrate 88% & mononitrobenzene 12% was used as the bursting charge in large Mines consisting of rectangular sheet-iron boxes. A 90/10 mixture was also used to increase the penetrating effect of shaped charges. This was accomplished by placing a glass ampoule, filled with the mixture, in the air space between the concave surface of the shaped charge and the shell nose. For maximum effect the initiator (fuze) was placed at the tail end of the charge, such as 60/40 Cyclotol.

Other Myrol explosive mixtures include:

a) Soft jellied mixtures obtained by incorporating 3-5% of Nitrocellulose, and adding pulverized solids. Such a solid filler was used as the bursting charge of Projector Mines.

b) Hard jellied Propellants obtained by incorporating 25-30% of Nitrocellulose into 75/25 Myrol. Such mixtures formed uniformly hard colloids suitable as Rocket Propellants.

c) A hard jellied explosive prepared by gelatinizing Nitrocellulose with a mixture of Methyl Nitrate 91-95% & mononitrobenzene 5-9%. It was used as a booster charge.

d) A solid, highly brisant explosive consisting of 30-40% of 75/25 Myrol with such amounts of hydrated calcium nitrate & lignin as to give a zero oxygen balance. This mixture was used as a bursting charge for Bombs & Land Mines.

Myrol (cont'd)

e) A solid explosive consisting of Methyl Nitrate/benzene (90/10) 30%, hydrated calcium nitrate 55%, fine aluminum powder 10% & pulverized peat 5%. This is a highly brisant & powerful explosive having a zero oxygen balance. It was proposed as the filler for warheads of V-1 & V-2 Rockets.

f) A solid explosive consisting of 85/15 Methyl Nitrate/mononitrobenzene gelatinized with Nitrocellulose, and mixed with sawdust & hydrated calcium nitrate. This mixture was used in Hand Grenades and in mining operations.

g) A solid brisant explosive consisting of Myrol, potassium nitrate, aluminum & peat. Such a mixture was used as the bursting charge in Hand Grenades & Land Mines, and in rock blasting.

Neorodit — HEXAMIT, NEORODIT

This is a commercial explosive consisting of Hexanitrodiphenylamine 60-70% & TNT 40-30%. It was used for rock blasting, uprooting stumps & general demolition.

See also Hexamit.

Nipolit — NIPOLIT

A Propellant or Explosive composition, developed during WW II at the Kraiburg plant of the Deutsche Sprengchemie Gesellschaft mit beschränkter Haftung. Two compositions are reported:

Nipolit (tubes). PETN 35%, Nitrocellulose (12.6% Nitrogen) 34.1%, Diethyleneglycol Dinitrate 30%, stabilizer 0.75%, magnesium oxide 0.05% & graphite 0.1%.

Nipolit (sticks). PETN 50%, Nitrocellulose (12.6% Nitrogen) 29.1%, Diethyleneglycol Dinitrate 20%, stabilizer 0.75%, magnesium oxide 0.05% & graphite 0.1%.

Nipolit is prepared by air-agitating a water slurry of Nitrocellulose & Diethyleneglycol Dinitrate in a lead-lined vessel. After 15-20 minutes stirring, the mass is centrifuged to remove all

Nipolit (cont'd)

but 25% of water. The resulting cake is kneaded at 50°C in a Werner-Pfleiderer machine with the calculated amount of PETN, some water, magnesium oxide & graphite. After 15 minutes of kneading, the paste is transferred to rubber-lined bags where it is allowed to age for 48-72 hours. The aged paste is passed 15-20 times thru a pair of vertical rolls maintained at 75°C (or 90-100°C) to produce a sheet which is later extruded at a pressure of 200 kg/sq cm & temperature of 80°C. The resulting tubes or sticks are cut into the desired lengths.

In using Nipolit the "stick" is wetted with acetone & pushed into the "tube", of such a length that one end is flush, leaving a cavity in the other end to accomodate a Detonator. This assembly was used as a booster charge in ammunition.

See also Hexolit; as well as Holtex under Swiss Explosives.

Nitrobaronit — DYNAMITE, NITROBARONIT

This is an early German, aluminized Ammonium Nitrate explosive. Two compositions were examined after WW II by L. Médard [Mémorial de l'Artillerie Francaise (Paris) 22, 569 (1948)]

Nitrobaronit A. Ammonium Nitrate 82%, Nitroglycerin 5%, liquid Dinitrotoluene 5%, petroleum tar 1.5%, wood meal 1.5% & aluminum 5%. Its CUP value is 124% (Picric Acid = 100).

Nitrobaronit B. Ammonium Nitrate 69%, Nitroglycerin 22%, Collodion Cotton 0.75%, liquid Dinitrotoluene 3%, tar 2%, wood meal 1.25% & aluminum 2%. Its CUP value is 126%.

See also Berclavit B.

Nitrocellulose (Nitrozellulose) — NITROCELLULOSE

Nitrochlorin — NITROCHLORIN

A low-freezing explosive oil consisting of Dinitrochlorohydrin 80% & Nitroglycerin 20%. It is prepared by nitrating commercial monochlorohydrin containing glycerin. It was used in the manufacture of military explosives & some commercial Dynamites.

NITROFORM
TRINITROMETHANE

Nitroform or Trinitromethan

This colorless crystalline compound, [$CH(NO_2)_3$], was prepared & examined during WW II by Dr. Schimmelschmidt who recommended its preparation from Tetranitromethane, potassium hydroxide & hydrogen peroxide. His preference for this method is based on the claim that the previous method of reacting Tetranitromethane, potassium hydroxide & hydrazine is hazardous since Hydrazoic Acid (Hydrogen Azide) is also formed in the reaction. Nitroform is liberated from its potassium salt by distillation at reduced pressure in the presence of sulfuric acid. The product has a melting point of 26.4°C vs 22°C obtained by previous investigators.

In the course of investigating the reactions between Nitroform & organic compounds, Dr. Schimmelschmidt obtained several highly explosive substances:

a) On treating Nitroform with vinyl-methyl ketone, Trinitropropylmethyl Ketone, $(O_2N)_3\ C \cdot CH_2 \cdot CH_2 \cdot COCH_3$, was obtained. This compound is similar to RDX in explosive power.

b) When acetylene was bubbled thru Nitroform containing a little mercuric nitrate and the product, $CH_2{:}CH \cdot C(NO_2)_3$, again reacted with Nitroform, an extremely powerful explosive was obtained. This product is believed to be a mixture of 1,4-Ditrinitrobutane, $(O_2N)_3C \cdot CH_2 \cdot CH_2 \cdot C(NO_2)_3$ & Hexanitroisobutane, $CH_3 \cdot CH[C(NO_2)_3]_2$.

c) Reaction of Nitroform with formaldehyde gave Trinitroethanol, $CH_2OH \cdot C(NO_2)_3$.

The possible military application of these explosives is not reported.

NITROGLYCERIN

Nitroglycerin or Nitroglyzerin

This explosive was manufactured in Germany by the nitration of glycerin either by a batch process or by a continuous method, such as that of Schmid, Meissner or Biazzi.

It was used primarily in the manufacture of Double-Base Propellants, and in mixtures with Nitroglycol for some composite military explosives & commercial Dynamites.

Nitroguanidin — NITROGUANIDINE

This explosive was prepared in Germany by treating Guanidine Nitrate with concentrated sulfuric acid at 45°C. It was used during WW II for the manufacture of Triple-Base Propellants, called Gudolpulver, and in a number of composite explosives. Nitroguanidine was also used alone in the nose of the 1800 kilogram Armor-Piercing Bomb as a protection (bumper) for the more sensitive main bursting charge consisting of Füllpulver Nr 109.

Nitrolit — NITROLIT

An Amatol-type explosive in which Trinitroanisole is used to replace TNT. The mixture, consisting of Trinitroanisole 60% & Ammonium Nitrate 40%, is light yellow in color, with a melting point of 75°C which permits it to be cast loaded. Its explosive properties are similar to those of US 60/40 Amatol (German Füllpulver Nr 88 or Fp 40/60), but it is hygroscopic.

Nitrolit was used as the bursting charge in Sea Mines & in Torpedoes.

Nitropenta or Nitropentaerythrit — PETN

See Pentrit.

Nitrozellulose (Nitrocellulose) — NITROCELLULOSE

Nobelit — GELATIN DYNAMITE NOBELIT

A permissible Ammonium Nitrate Gelatin Dynamite used between WW I & WW II.

See Nobelit under Swedish Explosives.

Octogen — HMX

This compound is present as an impurity in RDX manufactured either by the E-Verfahren (E-Process) or by the KA-Verfahren (KA-Process). The German found Octogen to be more sensitive to friction and more stable to heat than RDX.

See also Hexogen.

Parammon — PARAMMON

This explosive is a mixture of Ammonium Perchlorate 90% & paraffin 10%. A mixture of Ammonium Perchlorate & TNT gives a more brisant explosive, and a mixture with Dinitrobenzene gives a less sensitive explosive. These mixtures were developed for military purposes.

Pentol — PENTOLITE

See Füllpulver Nr 42 under Füllpulver.

Pentrit, Nitropenta or Nitropentaerythrit — PETN

PETN was manufactured in Germany by batch, continuous & semi-continuous methods. The batch method was essentially the same as that used in the USA. The continuous method was conducted at the Troisdorf Fabrik and the semi-continuous method at the Krümmel Fabrik of Dynamit Aktiengesellschaft. PETN was usually phlegmatized (desensitized) with 10% of either Montan wax or a synthetic IG Farben wax 41a.

Straight PETN was used under the name Füllpulver Nr 3 or Np (Nitropenta) as a Detonator, and as the bursting charge in Grenades & small-caliber Shells. Straight PETN was also used in a composite Propellant/Explosive called Nipolit.

The use of PETN-wax mixtures was much more common: As fillers for Shells, Bombs, Grenades & Sea Mines; as bursting charges for some shaped-charge ammunition; as standard Boosters in chemical & incendiary ammunition; as the standard Sub-Boosters in all types of ammunition; and as the core of Detonating Fuzes.

See also Füllpulver Nrs 16, 17, 17a, 28, 32, 33, 34, 36, 37, 38, (?), (?), (?), (?), 42, 43, 45, 52, 52a, Nipolit,

Pentritol — PENTOLITE

Same as Pentol. See Füllpulver Nr 42 under Füllpulver.

Perchloratit — CHEDDITE

This is a military & industrial demolition explosive. See under Cheddit .

Perchloratsprengstoffe (Perchlorate Explosives) — CHEDDITE

See Albit, Cheddit, Gesteinssprengstoffe, Leonit, Parammon.

Pfeifpatronen (Whistling Cartridges) — PYROTECHNICS

See Feuerwerkerei.

PH-Salz or Diamin — ETHYLENEDIAMINE DINITRATE

PH-Salz was prepared in Germany by treating ethylenedichloride with ammonia & sodium hydroxide, followed by nitrating with nitric acid (50% of less in strength). Although PH-Salz has a high melting point (185°C), it has the property of depressing the melting point of other high melting compounds. For this reason, PH-Salz is used in admixtures with Ammonium Nitrate with which it forms a eutectic. A mixture of PH-Salz 45% & Ammonium Nitrate 55% melts at 105°C and can be cast loaded. Such a mixture has explosive properties equal to TNT or Amatol (80/20), but it has the disadvantage of shrinking considerably on cooling. Addition of aqueous calcium nitrate to this mixture practically eliminates shrinkage and produces a very good cast.

The following mixtures containing PH-Salz were used during WW II as substitute bursting charges for filling some Shells:

a) Füllpulver Nr 20. See under Füllpulver.
b) Füllpulver Nr 83. See under Füllpulver.
c) Füllpulver Nr 84. See under Füllpulver.
d) Füllpulver Nr 86. See under Füllpulver.
e) Ammonit 43B. See Table 4 under AMMONITE.
f) Ammonit Nr (?). See Table 4.
g) Ammonit H-5. See Table 4.
h) Ammonit Nr (?). See Table 4.
i) Hexo S-22. See under Unterwassersprengstoffe.
j) Hexa S-22. See under Hexa Sprengstoffe.
k) S-16. See under Unterwassersprengstoffe.
l) Amatol 41. See under Amatol.

This compound was also used straight or slightly phlegmatized. When phlegmatized, it was particularly suitable as a bursting charge for use in Anticoncrete Shells, called Be-Granate (Beton = concrete) in German.

Pikrinsäure — PICRIC ACID

During WW II Picric Acid was manufactured for use as a compressed booster charge; as a filler for Shells, Land Mines & Depth Charges (Füllpulver Nr 2); and as a bursting charge in stick Hand Grenades (Füllpulver Nr 5). Cast Picric Acid was used under the name Füllpulver Nr 24.

Plastit — PLASTIT

A German plastic explosive developed during WW II. It consisted of RDX 64%, Collodion Cotton 3.5% & liquid or semi-liquid nitrohydrocarbons 32.5%. This explosive is less efficient than US Composition C2 because it contains less RDX.

See also Hexoplast 75.

Rauchsätze (Smoke Compositions) — PYROTECHNICS

See Feuerwerkerei.

Romperit 1 — DYNAMITE ROMPERIT 1

This is a WW II mining explosive consisting of Ammonium Nitrate 86%, Nitroglycerin/Nitroglycol 10% and TNT, aluminum & other ingredients 4%.

See also Donarit & Gelatinedynamit.

R-Salz — R-Salt

This compound, known in USA as Cyclotrimethylenetrinitrosamine & as R-Salt, was prepared in Germany by G. Römer et al, by treating Hexamethylenetetramine with sodium nitrate in acid solution. The freezing point of R-Salt alone is 104-106°C. It forms a eutectic with 28% Dimethylenedinitramine (freezing point 137°C) freezing at 74°C.

R-Salt was used in a number of composite explosive compositions, developed as main fillers for ammunition:

R-Salz (cont'd)

a) R-Salt 96.5%, phenantrene 2.5% & diphenylamine 1%. Its casting temperature is 92°C, density 1.55 gm/cc, velocity of detonation 7600 meters/second and fragment density 44 meters (TNT = 40).

b) R-Salt 96.5%, Dimethylenedinitramine 2.5% & diphenylamine 1%. Its casting temperature is 92°C, density 1.55 gm/cc, and velocity of detonation 7850 meters/second.

c) R-Salt 46.5%, RDX 50%, phenanthrene 2.5% & diphenylamine 1%. Its casting temperature is 92°C; density 1.65 gm/cc; lead plate test value, more effective than 50/50 Cyclotol; and fragment density 47 meters.

d) R-Salt 46.5%, potassium nitrate 50%, phenanthrene 2.5% & diphenylamine 1%. Its casting temperature is 94°C; density 1.77 gm/cc; velocity of detonation 6100 meters/second; lead plate test value, more effective than 60/40 Amatol; and fragment density 47 meters.

e) R-Salt 40%, RDX (phegmatized with 5% Montan wax) 40% & aluminum 20%.

f) R-Salt 36.5%, RDX 50%, aluminum 10%, phenanthrene 2.5% & diphenylamine 1%. Its casting temperature is 95°C; density 1.64 gm/cc; lead plate test value, more effective than 60/40 Amatol; and fragment density 47 meters.

g) R-Salt 36.5%, RDX 40%, aluminum 20%, phenanthrene 2.5% & diphenylamine 1%. Its casting temperature is 95°C; cast density 1.74 gm/cc; velocity of detonation 7750 meters/second; and lead plate test value, more than 60/40 Amatol.

h) R-Salt 36%, RDX 50%, Dimethylenedinitramine 12%, diphenylamine 1% & unaccounted 1%. Its casting temperature is 84°C.

All of the above compositions are reported to be of satisfactory stability at 100°C, and to show no evidence of exudation at 70°C.

Schiessbaumwolle or Schiesswolle — GUNCOTTON

This Nitrocellulose of 13.25% Nitrogen content corresponds approximately to US Guncotton.

Schiesswolle 18 or TSMV1-101 — SCHIESSWOLLE 18

This explosive is an aluminized Hexamit. It consists of TNT 60%, Hexanitrodiphenylamine 24% & aluminum 16%. It was used during WW II as a castable bursting charge in Sea Mines, Torpedoes, Depth Bombs & in underwater Demolition Charges.

See also Hexa & Hexamit.

Schwarzpulver — BLACK POWDER

German Black Powder compositions are as follows:

Militärpulver (Military Powder). Potassium nitrate 75%, charcoal 15% & sulfur 10%

Marine Geschützpulver (Navy Gunpowder). Potassium nitrate 75%, beech charcoal 16% & sulfur 9%.

Jagdpulver (Hunting or Sporting Powder). Potassium nitrate 78.5%, charcoal 11.5% & sulfur 10%.

Sprengpulver (Blasting Powder). a. Potassium nitrate 65%, charcoal 20% & sulfur 15%; b. Potassium nitrate 66%; charcoal 21.5% & sulfur 12.5%; c. Potassium nitrate 70%, charcoal 16% & sulfur 14%; d. Potassium nitrate 74%, charcoal 16% & sulfur 10%. These powders were manufactured by the Pulverfabrik Spandan near Berlin.

Sprengpulver. Sodium nitrate 65%, charcoal 18% & sulfur 17%.

Sprengpulver B. Potassium nitrate 76%, charcoal 14% & sulfur 10%.

SH-Salz — RDX

One of several German names for RDX depending upon its method of manufacture. SH-Salz is manufactured by the direct nitration of hexamethylenetetramine as described under Hexogen.

Sicherheitsdynamit (Safety Dynamite) DYNAMITE

This class of Dynamites contain 20-25% of Nitroglycerin (or a mixture of Nitroglycerin/Nitroglycol (4/1), Dinitrochlorohydrin (which serves as a phlegmatizer) & a "dope" (such as Ammonium Nitrate or wood meal). These explosives are safe to use, handle & transport.

See also Dynamit.

Signalmitteln (Signal Devices) PYROTECHNICS

See Feuerwerkerei.

Sinoxydsatz or Sinoxyd SINOXYDSATZ

See Tetrazen under Swiss Explosives.

Sprenggelatine (Blasting Gelatin) BLASTING GELATIN

German Blasting Gelatin contains Nitroglycerin 91-93% & Collodion Cotton (Nitrogen content 11.8-12.4%) 7-9%. The 93/7 mixture has the following properties: Density of loading 1.55 gm/cc; impact sensitivity with 2 kg weight 12 cm; velocity of detonation 7800 meters/second; Trauzl test value 520 cc; temperature of explosion 4210°C; volume of gases at NTP 712 liters/kg; and specific pressure 1200 kg/sq cm.

See also Dynamit & Gelatinedynamit.

Sprengkapsel (Blasting Cap) DETONATOR AND BLASTING CAP CHARGES

See under Detonatoren- und Sprengkapseln-Ladungen.

Sprengkörper 28 SPRENGKÖRPER 28

This name, meaning "explosive pattern 1928", is applied to charges of either TNT or Picric Acid pressed into blocks 2" X 1 5/8" X 2 3/4" wrapped in waxed paper, or placed in bakelite containers. These blocks were used during WW II as Demolition Charges in Land Mines, such as the Glasmine 43(f).

Sprengniet (Explosive Rivet) SPRENGNIET

The explosive composition consists of Mannitol Hexanitrate 25%, Tetracene 10% & aluminum powder 65%. It is a priming

Sprengniet (Explosive Rivet) (cont'd)

composition sensitive to flame, impact & friction. Its properties & use in explosive rivets are reported by E.R. von Herz et al [German Patent 708238 (June 1941) & Chemical Abstracts 37, 2938 (1943)] and by E.R. von Herz [Explosivstoffe 1954, 29-38 (1954)].

Sprengöl (Explosive Oil) — NITROGLYCERIN

See Nitroglycerin.

Tetan, Tetranitromethan or X-Stoff — TETRANITROMETHANE

As the classical method of preparing "Tetan" from acetic anhydride & nitric acid was considered very expensive, a new method was developed in Germany, during WW II, by Dr. Schimmelschmidt. The procedure developed is essentially the reaction between acetylene & nitric acid to give Nitroform (Trinitromethane), and the heating of a mixture of Nitroform & nitric acid with sulfuric acid to yield Tetranitromethane. This colorless liquid, $C(NO_2)_4$, has a freezing point of -14°C.

The first "Tetan" explosive mixture used consisted of very finely pulverized aluminum powder (called Pyroschliff), "Tetan", a hydrocarbon rich in hydrogen & a highly dispersed silica (called K_3-Stoff) as a consolidating agent. This solid composition possesses a very high blast effect and a comparatively low velocity of detonation. It was used as a bursting charge in underwater ammunition. Other composite explosives consisted of "Tetan" with liquid or pulverized carbon containing substances such as hydrocarbons, coal, charcoal & nitrocompounds. Some of these mixtures are more powerful & brisant than TNT, Picric Acid, PETN or RDX. One of the most powerful & brisant explosives known is a mixture of "Tetan" & toluene, which has a velocity of detonation about 9300 meters/second.

See also Nitroform.

Tetranitrocarbazol or Gelbmehl (Yellow Flour) — TETRANITROCARBAZOLE

This yellow-colored explosive compound, because of its non-hygroscopic & non-corrosive nature, was proposed during WW II as a

Tetranitrocarbazol (cont'd)

substitute for Black Powder in rocket-type illuminating flare & igniter compositions. Prior to 1945 the Germans used Black Powder as the "intermediate" igniter composition which, in contact with magnesium-containing flare compositions, was found to cause deterioration of the pyrotechnic device. In order to avoid destruction of any pyrotechnic devices in storage, and to prevent any future devices from becoming unserviceable, the following composition was developed to replace Black Powder: Tetranitrocarbazole 30%, potassium nitrate 40% & aluminum powder 30%.

Tetranitromethan — TETRANITROMETHANE

See Tetan.

Tetra-Salz — TETRA-SALZ

This compound was prepared in Germany in the pure state by the interaction of Methyl Nitrate with trimethylamine. It is not, itself, an explosive, but it forms powerful explosive compositions when mixed with oxidizing agents, such as nitrates. Mixtures of Tetra-Salz with nitrates were found to be suitable bursting charges in Projectiles, and for the preparation of Propellants for cannons & rockets.

See Ammonit Nr (?) in Table 4 under AMMONITE.

Tetrazen — TETRACENE

This compound was prepared in Germany using the same equipment as used in the preparation of Lead Azide & Lead Styphnate. Tetracene was used as an ingredient of some initiating and priming compositions. See Tetrazen under Swiss Explosives.

See also Initialsprengstoffe & Zündhütchensätze.

Tetryl — TETRYL

The Germans used a semi-continuous method for the manufacture of Tetryl at the Troisdorf Fabrik DAG. The moist Tetryl was recrystallized from acetone by a special process (vaguely described) and then dried & screened.

Tetryl was used during WW II as a sub-booster in some Projectiles, in gasless electric delay Detonators, and as a bursting charge in some Land Mines.

Trialen — TRIALEN

This is a group of explosives consisting of mixtures of RDX, TNT & aluminum. They are similar to US Torpex compositions. Trialens were used during WW II as bursting charges in underwater ammunition.

See Füllpulver Nrs 105, 106, 107 & 109.

Trinitrobenzol — TRINITROBENZOL

This explosive compound was used during WW II as a military explosive, in Primers, under the name Füllpulver Nr 70.

Trinitrochlorbenzol — TRINITROCHLOROBENZOL

This explosive compound was used during WW II, compressed, under the name Füllpulver Nr 60; cast, under the name Füllpulver Nr 61; and, in admixture with Ammonium Nitrate, under the name Füllpulver Nr 64.

Trinitromethan — TRINITROMETHANE

See Nitroform.

Trinitrotoluol or Trotyl — TNT

This explosive is also known as Füllpulver 02 or Fp 02 because it was officially adopted in Germany in 1902 as a military explosive. Its actual use by the Army began in 1904 and its

Trinitrotoluol or Trotyl (cont'd)

industrial production started in 1906 at the Schlebusch Fabrik, DAG.

During WW II TNT was manufactured by the following methods:

a) "batch" method of three-stage nitration of toluene, at the Schlebusch & Krümmel Fabriken of DAG.

b) "semi-continuous" method, by continuous mononitration of toluene, and batch processes of di- & trinitration, at the Allendorf Fabrik of DAG.

c) "continuous" vapor phase nitration of mononitrotoluene at Allendorf Fabrik of DAG.

d) "continuous" nitration of mononitrotoluene by the method of J. Meissner & by the method of Dr. Demoeff et al at the Schlebusch Fabrik of DAG.

The crude TNT was purified by: 1. washing with hot water, crystallizing & treating with Sellite (sodium sulfite solution); 2. continuous method of washing with hot water, with sodium bicarbonate solution & with 5% Sellite solution; and 3. crystallizing from 60% nitric acid solution & washing with hot water.

Straight-cast TNT was used as a bursting charge in a. HE Shells, such as 37 mm, 47 mm, 50 mm (Trench Mortar), 75 mm, 75 mm (Smoke) & 105 mm (Howitzer); b. Armor-Piercing Shells such as 75 mm, 75 mm (Capped) & 47 mm (Round Nose); c. Land Mines such as Tellermine & Antipersonnel Mine (Schi-Mi DM31) Model 1960. See Füllpulver Nrs 8, 14 & 16.

Pressed TNT was used in some Detonators & Boosters. For example the 47-mm HE Shells contained 3 pressed pellets of TNT coated with wax (density of pellets 1.49 gm/cc). See Füllpulver Nrs 1 & 7.

TNT desensitized with 3-20% of Montan wax was used in some Armor-Piercing & Semi-Armor-Piercing Shells. The higher wax content mixture was used in the nose where the shock of impact is greatest. Some of these TNT/wax mixtures are known as Füllpulver Nrs 6, 10, 11, 12, 27, 28, 29, 30 & 101.

Trinitrotoluol or Trotyl (cont'd)

TNT was also used in admixtures with other explosive & non-explosive ingredients to make composite cast-loaded & press-loaded bursting charges. See Füllpulver Nrs 13, 13a, 13-113, 15, 17, 18, 19, 21, (?), 42, 56, 95, 102, 105, 106, 107, 108 & 112.

Tritolital — TRITOLITAL

See Füllpulver Nr 108 (?) under Füllpulver.

Triwestfalit SN — ENERGIT

See Energit.

TSMV 1-101 — SCHIESSWOLLE 18

See Schiesswolle 18.

Unterwassersprengstoffe — UNDERWATER EXPLOSIVES

Extensive studies of underwater explosives were conducted in Germany prior to and since WW I. In addition to such composite explosives as Amatol, Ammonit, Hexa Sprengstoffe, KMA-Ladung and others used in underwater ammunition, the following were developed & used during WW II:

S-6. TNT 40%, Hexanitrodiphenylamine 30%, Dinitrodiphenylamine 20% & aluminum 10%.

S-6 Modifiziert. TNT 30%, Hexanitrodiphenylamine 35-30%, Dinitrodiphenylamine 15-20% & aluminum 15-25%.

S-16. Ammonium Nitrate 32%, sodium nitrate 8%, RDX 10%, Ethylenediamine Dinitrate 10% & aluminum 40%.

S-19. Ammonium Nitrate 73.3%, sodium nitrate 17.4% & urea 9.3%.

Hexo S-19. Ammonium Nitrate 55%, sodium nitrate 9%, potassium nitrate 4.2%, RDX 15%, urea 1.8% & aluminum 15%.

Hexo S-22. Ammonium Nitrate 55%, sodium nitrate 9%, potassium nitrate 8%, RDX 14% & Ethylenediamine Dinitrate 14%.

Unterwassersprengstoffe (cont'd)

The following two experimental compositions proved to be very promising as underwater explosives:

a) Ammonium Perchlorate 50%, RDX 10% & aluminum 40%. This mixture is about 2 1/2 times as effective as TNT.

b) TNT 57%, Ammonium Nitrate 29% & aluminum 14%. This mixture can be cast loaded, and it can be press loaded to a density of 1.84 gm/cc, making it a very efficient explosive composition.

Westfalit

DYNAMITE
WESTFALIT

This is a series of blasting explosives used in Germany since 1893. The original composition contained Ammonium Nitrate 95% & resin 5%. It was later modified to Ammonium Nitrate 91%, potassium nitrate 4% & resin 5%. This latter composition has a velocity of detonation of 4350 meters/second at a density of 1.01 gm/cc. It is called "Westfalit für Kohle" (Coal Westfalit).

Although Westfalit is fairly safe to use in gaseous coal mines, the Westfälisch-Anhaltische Sprengstoff A-G proposed to add to them 3-5% of chromium salts which act as cooling agents. Dynamites of this type are also manufactured in England under the name "Westphalite".

See also Gesteins-Westfalit under Gesteinssprengstoffe.

Wettersprengstoff

DYNAMITE
WETTERSPRENGSTOFF

This is a class of coal mining explosives corresponding approximately in composition to US "Permissible Explosives" & French "Explosifs Antigrisouteux".

Some Dynamites which belong to this class of explosives include: Bikarbit, Chaücit, Carbonit, Donarit, Nobelit and others which are tabulated in detail in Picatinny Arsenal Technical Report 2510 (1958), pages 260-61.

Zündhütchensätze, Zündsprengstoffe & Initialsprengstoffe

INITIATING EXPLOSIVES
& PRIMING COMPOSITIONS

See Initialsprengstoffe.

Unusual Research & Development in the Field of Explosives

"Explosive Aerosol Clouds"

In his book "Vom Krieg zur Staatsnotwehr" (From War to National Defense), Colonel Alfred Troeller describes aerosol cloud space explosions initiated by contact with oil, fat, grease & even human flesh. His conclusion that "space explosions are a reality" is based on:

a) an experiment with a box of powdered coal blown up to form a coal dust which was subsequently detonated with a special fuze manufactured by Rheinmetall, Troisdorf;

b) the Ludwigshafen accidental explosion of 1947; and

c) some experimental work done at J. Schaberger & Co, GMBH, Gau-Algeshein/ Rhein.

This firm has applied for a patent since developing a procedure, based on the idea of Troeller, for combating vehicles, vessels & aircraft operated by Otto or Diesel fuels.

The invention describes a Projectile for the generation of gas clouds which have a detrimental effect on internal-combustion engines in operation. Chemicals are separately placed in the Projectile and generate Chlorine Azide or Chloroazide when the Projectile is set off. Particularly suitable for this purpose is a mixture of sodium azide (nonexplosive) & sodium chlorate acted on by acetic acid, which is separated from the solids by a membrane later ruptured by a detonator. The components react to form Chlorine Azide.

When a vehicle moves or flies into this cloud, the aerosol is sucked in simultaneously with the air needed for combustion. On mixing with the fuel vapor, the aerosol ignites spontaneously, causing serious damage or destruction of the engine. It is not necessary that the percentage of aerosol be high, as the effect may cause preignition of the fuel-air mixture, or intensification of the explosion pressure. It is assumed that turbine aircraft, which require a high rate of air flow and have elements extremely sensitive to explosion thrusts, will be damaged or destroyed at a lower aerosol concentration than is required for Diesel engines.

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Italian Explosives

During WW II, the Italians had several large explosive & ammunition plants that produced materials of good quality and in a quantity nearly sufficient for their needs. Italian explosives & artillery have always been considered of very good quality. With the exception of T4 (Cyclonite) and Tritolita (Cyclotol), which the Italians used before both Britain & the USA, there are no high explosives of unusual interest or originality. However, there are several explosives, similar to the German Ersatzsprengstoffe (substitute explosives), which were developed in Italy due to the shortage of aromatic compounds.

The principal explosives known to be used are listed alphabetically in the following pages.

Acido d'argento, Azotidrato d'argento or Azotidruro d'argento — SILVER AZIDE

It is used in some priming compositions.

Acido di piombo, Azotidrato di piombo or Azotidruro di piombo — LEAD AZIDE

It has almost entirely replaced Mercury Fulminate as an initial detonating agent & ingredient of priming compositions. It is used alone and in admixture with Lead Styphnate because the latter is more sensitive to flame initiation. This explosive was manufactured by the Società Anonyma Nobel SGEM at Tiano near Torino, and by the Società Anonyma Bombrini Parodi-Delfino at Colloferro-Roma.

Acido picrico, Melinita, Pertite or Trinitrofenolo — PICRIC ACID

It has a cast density of 1.64 gm/cc; compressed density 1.74 gm/cc; and Trauzl test value of 295 cc. It is used straight for cast loading 100-mm, 120-mm & 149-mm Shells, and in several composite explosive mixtures such as MABT, MAT, MBT, Polvere verde & Victorite.

Acido stifnico or Trinitroresorcina — STYPHNIC ACID

It is used in the form of its lead salt (Lead Styphnate) as an igniting charge for Lead Azide and as an ingredient of Priming Compositions. See Trinitoresorcinato di piombo.

Afocite — AFOCITE ; AMMONIUM NITRATE DYNAMITE

A blasting explosive composition for which two mixtures are reported: a) Ammonium Nitrate 58-62%, potassium nitrate 28-31%, carbon 7-9% & sulfur 2-3%; b) Ammonium Nitrate 58-62%, potassium nitrate 31-38%, charcoal 3.5-4.5%, sulfur 2-3% & moisture 1.5%.

Albite — ALBITE

A high explosive composition invented by Bernadini & Manuelli. It consists of Ammonium Nitrate 58.6%, Nitroguanidine 19.1% and Guanidine Nitrate 22.3%. It was used during WW II as a bursting charge in some Projectiles.

Amatolo AMATOL

80/20, 70/30 and 60/40 (called Esplovivo 60/40) Amatols are used in filling various kinds of Shells, Bombs and Grenades.

90/10 Amatol is used in mining operations. Its properties are gap test value 2.0 cm; detonation velocity 2500 meters/second; and Trauzl test value 365 cc.

See also MST or Nougat.

Ammonal AMMONAL

Some pre-WW II Ammonals included: a) Ammonium Nitrate 54%, mononitrobenzene 20%, aluminum 24% & carbon 2%; b) Ammonium Nitrate 65%, TNT 15%, aluminum 17% (of which 16% was coarse and 1% fine powder) & carbon 3%.

Some WW II Ammonals included: c) Ammonium Nitrate 84.5%, potassium nitrate 1.5%, barium nitrate 0.5%, aluminum 5.5% & Black Powder 8.0%. It required a booster for detonation; d) Ammonium Nitrate 72 to 95%, aluminum 2 to 25% & carbon 0.8 to 3%; e) Ammonium Nitrate 46 to 64%, TNT 15 to 30%, aluminum 17 to 22% & carbon 3%. This latter composition is also called Toluol-ammonal. In some compositions Trinitronaphthalene is used in lieu of TNT.

See also Nitramit or Avigliana 3 & Sabulite.

Ammon dinamite (Gelatina 65%) GELATIN DYNAMITE

See Dinamite.

Ammon gelatina GELATIN DYNAMITE

See Dinamite.

Ammonite No. 1 AMMONITE

A commercial blasting explosive consisting of Ammonium Nitrate 88%, Dinitrotoluene 3%, vegetable flour 5% & Nitroglycerin 3%, plus traces of diphenylamine.

ANS or
Antisanzionite | ANS

A castable explosive composition proposed by M. Tonegutti, consisting of Ammonium Nitrate 60%, PETN 20%, guanidine nitrate 10% & dicyanodiamide 10%. It has a low melting point (104°C) due to the presence of the last two ingredients. It was used during WW II as a bursting charge for Navy Projectiles. When used in underwater ammunition such as Torpedoes, Depth Charges & Sea Mines, its efficiency is increased by incorporating some aluminum powder in the mixture. Compare with ASN.

Artifizi da guerra or Pirotecnia | PYROTECHNICS

See Pirotecnia.

ASN Esplosivo (or ASN Miscela) | ASN ESPLOSIVO

An explosive composition consisting of Ammonium Nitrate 70%, PETN 20% & dicyanodiamide 10%. Its properties are: Density 1.55 gm/cc; rate of detonation 5500 meters/second; equation of decomposition:

$$14\ NH_4NO_3 + 2(CN.NH_2)_2 + C(CH_2ONO_2)_4 \longrightarrow$$
$$9\ CO_2 + 36\ H_2O + 20\ N_2$$

volume of gases evolved according to this reaction 972 liters/kg at NTP; and heat evolved 938 kcal with H_2O considered vapor. Its uses are not reported.

Astralite | AMMONIUM NITRATE DYNAMITE ASTRALITE

An Ammonium Nitrate dynamite, somewhat similar to Ammonite. It was manufactured prior to WW II by the Società Dinamite and used as a main filler in Trench Mortars & Hand Grenades. It is now used in blasting of rock and in mining operations.

Avigliana 3 or Nitramite | AMMONAL

See Nitramite.

Azotidrato d'argento,
Azotidruro d'argento or
Acido d'argento | SILVER AZIDE

Azotidrato di piombo,
Azotidruro di piombo or
Acido di piombo — LEAD AZIDE

Balistite — BALLISTITE

A Nitrocellulose/Nitroglycerin Propellant used during WW II as a bursting charge in some small-caliber Projectiles, such as 37/40-mm HE & 37/40-mm HE Armor-Piercing Shells.

BM (Esplosivo) — DYNAMITE

A series of mining explosives manufactured by Esplosivi Mangiarotti, Codroipo (Udine), Italia. Many of these Dynamites are based on Ammonium Nitrate with other explosive & non-explosive ingredients added. Their exact compositions are not reported but their properties and methods of testing are given in detail in company Catalogue.

Cadinite — CADINITE; DYNAMITE

An industrial mining explosive consisting of Nitroglycerin 26%, sodium nitrate 56%, sulfur 10% & carbon or cellulosic substance 8%.

Cheddite — CHEDDITE

These explosive compositions, known since 1897 and used during WW II, are brown to gray plastic substances based on chlorates or perchlorates of ammonium, potassium & sodium. Other ingredients are combustible materials & binders. Such mixtures are inferior to Dynamites in explosive properties and some are of unsatisfactory stability. Due to their high sensitivity to mechanical action, they are not suitable as bursting charges for Projectiles. They are used as the explosive charge for Land Mines. See also Cremonite, Esplosivo 86/14, Esplosivo P, Esplosivo S, Manlianite, Polvere cannel & Romite.

Cloramite — CLORAMITE; DYNAMITE

A mining explosive, utilizing scrap military propellants, consists of Ballistite or Cordite 64%, Ammonium Perchlorate 20%, sodium nitrate 15% & potassium dichromate 1%.

Composizione primaria & Composizione innescante — PRIMING & INITIATING COMPOSITION

The following Priming & Initiating compositions were found in Italian ammunition captured during WW II:

a) Potassium Chlorate 43 ± 2%, antimony trisulfide 23.5 ± 3%, Mercury Fulminate 23 ± 3% & abrasive 9 ± 3% - used as a Primer in some cartridge cases, such as the 47-mm APRN (Armor-Piercing, Round Nose) Shell.

b) Potassium Chlorate 44%, antimony trisulfide 48%, Mercury Fulminate 6% & abrasive 2% - used as a Primer in Fuzes of some Shells, such as the 47-mm APRN & in Fuzes of some Bombs.

c) Lead Azide 55 ± 7%, Lead Styphnate 44 ± 7% & binder 1% - used as the upper charge in Detonators of some Shells. The base charge consists of compressed RDX.

Composizione tracciante — TRACER COMPOSITION

A typical composition examined at Picatinny Arsenal during WW II contained barium nitrate 63.0%, magnesium powder 34.3% & binder-fuel 2.7%. This tracer was used in 47-mm Armor-piercing ammunition.

Colonel A. Izzo, "Pirotecnia e Fuochi Artificiali", Hoepli, Milano (1950), pages 210, 213 & 235, reports the following compositions:

Red (rosso) colored tracer - strontium peroxide 40%, magnesium powder 40% & strontium oxalate 20% (this composition may also contain as much as 40% strontium oxalate).

Green (verde) colored tracer - barium peroxide 72.5%, barium oxalate 5%, magnesium powder 15% & shellac 7.5%.

Yellow (giallo) colored tracer - potassium nitrate 50%, red arsenic 30% & sulfur 20%.

Cotone fulminante or Fulmicotone — GUNCOTTON

Cremonite — CHEDDITE

An older Cheddite type of explosive, proposed by U. Alvisi, consisting of Ammonium Nitrate 48.8% & Ammonium Picrate 51.2%.

Cresilite or Trinitro-meta-cresolo — CRESILITE

A golden yellow crystalline compound $CH_3.C_6H(NO_2)_3OH$, called 2,4,6-Trinitro-m-cresol. It melts at 107^o and explodes at 150^o C. It is prepared from m-cresol by methods similar to the preparation of Picric Acid from phenol. This compound is a powerful explosive used alone at one time as a bursting charge.

The mixture of 60% Trinitro-m-cresol & 40% Picric Acid, originally developed in France and called "Crésylite No. 2", was used in Italy as a bursting charge for large-caliber shells. This mixture has a melting point of 85^o C & density 1.77 gm/cc (cast); is less sensitive to shock & impact and slightly less powerful than Picric Acid alone.

The name Cresilite has been applied sometimes to Trinitro-m-cresol alone, and to its mixtures with Picric Acid. See also Ecrasite in this section and Crésylite & Ecrasite under French Explosives.

Dinamite — DYNAMITE

Dynamites are divided into two classes:

I. Dinamite a base inerte (Dynamites with inert base)

a) Tipo I - Nitroglycerin 70-75% & kieselguhr 30-25%

b) Tipo II - Nitroglycerin 50% & kieselguhr 50%

c) Dinamite al coke o Dinamite nera (Black Dynamite) - Nitroglycerin 45-55% & coke 55-45%

d) Dinamite al carbone di legno (Charcoal Dynamite) - Nitroglycerin 90% & charcoal 10%

e) Dinamite rossa (Red Dynamite) - Nitroglycerin 68% & tripoli (kieselguhr) 32%

f) Wetter dinamite (Permissible Dynamite) - Nitroglycerin 35-40%, kieselguhr 14-10% & magnesium sulfate 32-50%

II. Dinamiti a base attiva (Dynamites with active base)

g) Gelatina gomma o Gelatina esplodente (Blasting Gelatin) Nitroglycerin 92-93% & Collodion Cotton 8-7%

h) Gelatina esplosiva da guerra (Military Blasting Gelatin) - Nitroglycerin 86.4%, Collodion Cotton 9.6% & camphor 4.0%

i) Gelatina dinamite - Nitroglycerin 67-86%, Collodion Cotton 3-5.5%, potassium nitrate 5-25% & woodflour 2-10%

Dinamite (cont'd):

j) Ammon dinamite (Gelatina 65%) - Nitroglycerin 63%, Collodion Cotton 2%, Ammonium Nitrate 30% & woodflour 5%

k) Gelatina dinamite incongelabile o antigelo (Non-freezing Gelatin Dynamite) - Nitroglycerin 20-55%, Collodion Cotton 1-2%, nitrotoluenes 8-21%, sodium nitrate & Ammonium Nitrate 25-60% & cereal flour 1-8%

l) Gelatina 40% - Nitroglycerin 40%, drip oil (liquid Dinitrotoluene) 10%, sodium nitrate 44% & cereal flour 6%

m) Ammon gelatina I - Nitroglycerin 40% (gelatinized with Collodion Cotton), Ammonium Nitrate 45%, sodium nitrate 5% & woodflour 10%

n) Ammon gelatina II - Nitroglycerin 20% (gelatinized with Collodion Cotton), Ammonium Nitrate 75% & woodflour 5%

o) Gelatina Vender o Dinamite incongelabile Vender (Gelatin of Vender or Non-freezing Dynamite of Vender) - A series of explosives invented by Venzio Vender and manufactured before WW II at the Dinamitificio di Cengio. They are based on Nitroglycerin mixed with 10-30% of dinitromonoformin or dinitromonoacetin and the other usual ingredients of Dynamites. It is claimed that these explosives remain plastic at temperatures as low as -20°C.

p) Dinamite No 1 (Non-gelatinizzate) - Nitroglycerin 70-74% & woodflour 30-26%

q) Dinamite No 2 (Non-gelatinizzate) - Nitroglycerin 35-48%, charcoal or cereal flour 12-17% & sodium nitrate and/or potassium nitrate 52-39%

r) Unknown Name Dinamite - Nitroglycerin 20-25%, Ammonium Nitrate 20-25%, sodium nitrate 30-35 & charcoal 20%.

Dynamites or other explosives safe to use in gaseous coal mines are called "Esplosivi antigrisoutosi", "Esplosivi di sicurezza" or "Esplosivi ammissibili". Dynamites were used by the Army during WW II in some Demolition Charges & as bursting charge in some Hand Grenades.

AMMONIUM NITRATE DYNAMITE
DINAMON

Dinamon

A mining explosive consisting of Ammonium Nitrate 69%, Potassium Chlorate 8%, TNT 20% & aluminum 3%. This explosive, at a density of 1.10 gm/cc, has a gap test value of 4.5 cm.

Echos or Escho ECHOS

A military explosive consisting of Ammonium Nitrate 75-80%, aluminum powder 2-3%, ferrosilicon or silicon 14-16% & dried pulverized horse dung (called "ipposino") 5-7%. This explosive is reported to be used also in France.

Ecrasite — AMMONIUM TRINITROCRESYLATE

The ammonium salt of Trinitrocresol was used by the Austrians during WW I under the name Ekrasit for filling some shells, and by the Italians during WW II as a bursting charge in large shells. The 60/40 mixture of Picric Acid & Trinitro-m-cresol is also called Ecrasite by R. Molina, "Esplodenti e Modo di Fabbricarli", Hoepli, Milano (1930), page 391. See Cresilite.

Esanitrodifenilammina, Exil or p-Dipicrilammina — HEXANITRODIPHENYLAMINE

Yellow crystals melting at 240°C, explosion temperature 250-60°C, velocity of detonation 7150 meters/sec at density 1.67 gm/cc & Trauzl test value 320 cc. In general, its explosive properties are intermediate between those of TNT & Tetryl. This compound has been used, alone and in mixtures with TNT(such as German Hexamite), as a base charge in Detonators, and in some mining explosives consisting of TNT, Ammonium Nitrate & Hexanitrodiphenylamine.

Esanitrosorbite — HEXANITROSORBITOL

An explosive compound first prepared & examined during WW II by A. Tettamanzi & N. Arnaldi, as reported in Atti della Accademia delle Scienze di Torino, Classe di Scienze Fisiche, Matematiche e Naturali 77, 278-81 (1942) & Chemical Abstracts 38, 3841 (1944). This compound, $O_2N.O.CH_2[CH(O.NO_2)]_4\ CH_2O.NO_2$, was obtained from sorbitol of high purity by nitration with fuming nitric acid below 0°C and gradual addition of sulfuric acid at below -15°C. The product obtained as platelets from alcohol (97% yield) has a melting point of 55.5°C and density 1.58 gm/cc.

Properties of the compound are reported as follows: Heat of combustion 1465 kcal/kg; heat of formation 135 kcal/mole; heat of explosion 1500 kcal/kg; and rate of detonation 7230 meters/sec. Its sensitiveness to impact & stability are similar to Nitroglycerin. Although it is reported to be a brisant explosive, Hexanitrosorbitol is not considered a satisfactory substitute for Nitroglycerin as a gelatinizing agent for Nitrocellulose because of physical changes which occur in the mixture.

The use of this compound in military explosives is not reported.

Escho or Echos — ECHOS

See Echos.

Esplosivo 60/40 — AMATOL

See Amatolo.

Esplosivo 86/14 — CHEDDITE

A Cheddite-type explosive consisting of Ammonium Perchlorate 86% & paraffin 14%.

Esplosivo ammissibile,
Esplosivo antigrisoutoso or
Esplosivo di sicurezza (Safety Explosive) — PERMISSIBLE EXPLOSIVE

Esplosivo ASN — ASN ESPLOSIVO

See ASN Esplosivo.

Esplosivo da guerra — ESPLOSIVO da GUERRA

Among the recently proposed military explosives mixtures, the following should be mentioned:

Bursting Explosive - RDX (or PETN) 75% is incorporated with 25% of nitroisobutylglycerol triacetate at 80°C. [Ref: "Montecatini" Società Generale per l'industria mineraria e chimica, Italian Patent 433633 (13 April 1948) & Chemical Abstracts 44, 1709 (1950)].

Bursting Explosive - TNT 30-90%, RDX (or PETN) 5-65%, & powdered metal (such as silicon, boron, magnesium, copper, iron, aluminum or zinc) 5-30%. The TNT can be partially substituted by dinitronaphthalene 15-45%. [Ref: Polverifici Giovanni Stacchini SA, Italian Patent 433636 (13 April 1948), 445206 (10 February 1949); 445601, 445602 & 445603 (22 February 1949) and Chemical Abstracts 44 1709 (1950); 45 1770 & 3160 (1951)].

Bursting Explosive - RDX 86-92% mixed with castor oil 8-14% and processed in the form of beads. [Ref: Direzione Superiore del Servizio Tecnico di Artiglieria a Roma, Italian Patent 450103 (8 July 1949) & Chemical Abstracts 44, 11098 (1950)].

Esplosivo da mina or
Polvere da mina — DYNAMITE

Esplosivo da mina gelatinoso con nitroglicerina

GELATIN DYNAMITE

Gelatinous mining explosives with Nitroglycerin are listed by C. Belgrano, "Gli Esplosivi", Hoepli, Milano (1952), pages 280-81. Some examples of the 29 such explosives are given here:

Composition (%) and Some Properties	I GDII	2 GD2	3	4 GDI	5 GDIM	6 GEOM	7	8	9 GEO	Gomma B	A
Nitroglycerin	43.2	48.3	7.0	60.0	38.0	57.0	71.0	40.75	77.5	82.5	92
Collod. cotton	2.3	2.7	0.8	3.5	2.3	3.5	5.0	1.5	5.0	5.5	8
Am nitrate	-	-	-	-	50.9	29.0	-	17.0	-	-	-
Am perchlorate	-	-	44.0	-	-	-	-	-	-	-	-
Woodflour	7.0	5.8	1.0	5.2	-	3.5	5.0	-	5.0	3.0	-
Dinitrotoluene	-	-	10.0	-	-	-	-	-	-	-	-
Trinitrotoluene	-	-	5.0	-	-	-	-	-	-	-	-
Na nitrate	45.5	42.7	32.2	30.5	6.0	7.0	-	-	12.0	8.5	-
K nitrate	-	-	-	-	-	-	18.5	-	-	-	-
Oa silicide	-	-	-	-	-	-	-	-	-	-	-
Oil	-	-	-	-	2.0	-	-	-	-	-	-
PETN	-	-	-	-	-	-	-	40.75	-	-	-
Ocher, red (hematite)	-	-	-	0.3	0.5	-	0.5	-	-	-	-
Ocher, yellow (limonite)	1.0	-	-	-	-	-	-	-	-	-	-
Na carbonate	1.0	0.5	-	0.5	-	-	-	-	0.5	0.5	-
Oa carbibate	-	-	-	-	0.3	-	added 0.3	-	-	-	-
Trauzl test, cc	340	355	430	440	475	500	505	525	540	560	630
Gap test, cm	14	15	6	20	21	23	26	25	29	30	35
Veloc. of deton., m/sec.	5000	5200	4700	6000	5900	5400	5900	7000	6700	6900	7200

Esplosivo da mina polverulento con nitroglicerina — AMMONIUM NITRATE DYNAMITE

A series of pulverulent mining explosives with Nitroglycerin & Ammonium Nitrate as the principal ingredients. C. Belgrano, "Gli Esplosivi", Hoepli, Milano (1952), pages 282-83, lists 30 such compositions, of which selected examples are given here:

Composition (%) and Some Properties	1	2	3	4	5	6	7	8	9	10	11	12
Nitroglycerin	14.0	11.0	10.0	4.0	4.0	8.0	12.4	12.76	4.0	12.0	11.7	9.0
Dinitrotoluene	-	-	-	1.5	-	0.5	0.3	-	-	-	-	-
Trinitrotoluene	-	-	-	-	-	-	-	-	10.0	0.3	-	20.0
Collodion cotton	0.3	-	0.25	1.5	0.1	0.5	0.3	0.24	-	-	0.3	0.3
Woodflour	-	6.0	-	-	-	-	-	-	-	-	-	-
Cereal flour	-	-	-	-	-	5.0	-	-	-	3.0	-	-
Am nitrate	65.7	51.0	89.75	82.0	89.4	81.0	79.0	83.0	76.0	77.7	76.0	70.7
Ma nitrate	-	-	-	-	-	-	-	-	-	-	-	-
K nitrate	-	-	-	-	-	-	-	-	-	-	-	-
Dinitronaphthalene	-	10.0	-	-	-	-	8.0	4.0	10.0	-	10.0	-
K perchlorate	-	-	-	-	-	-	-	-	-	-	-	-
Ma chloride	20.0	22.0	-	11.0	-	-	-	-	-	-	-	-
T4 (RDX)	-	-	-	-	6.5	-	-	-	-	-	-	-
Oil	-	-	-	-	-	-	-	-	-	2.0	2.0	-
Ca silicide	-	-	-	-	-	5.0	-	-	-	5.0	-	-
Trauzl test, cc	270	265	300	305	320	375	390	390	400	420	430	450
Gap test, cm	2	5	20	3	12	6	3	4	11	1	1	6
Velocity of deton. m/sec.	2120	2300	2038	1710	2500	3200	2715	3200	2348	2960	2350	2912
Uses	C&SM	C&SM	C&SM	CM	G&OM	C&SM	C&SM	C&SM	OM	OM	OM	G&OM

Abbreviations: CM - Coal Mines; C&SM - Coal & Sulfur Mines; G&OM - Galliers & Open Mines; OM - Open Mines Only

Note: Composition No. 3 is called Grisoutina

Esplosivo da mina con residuati di polveri di lancio — DYNAMITE

After WW II considerable amounts of left-over propellants (both of American & Italian origin) were left unused in Italy. Some of these propellants were used to prepare mining explosives. The usual procedure is to grind a propellant to pass a sieve with 16 openings per sq cm (US Std Sieve No. 12) and to mix it with an oxidizer and other ingredients ground to pass a sieve with 20 openings per sq cm (US Std Sieve No. 14). C. Belgrano, "Gli Esplosivi".

Composition (%) and Some Properties	1	2	3	4	5	6	7	8	9	10	11	12
Ballistite	45	12	-	60	10	10	10	-	50	-	-	-
Polvere B	-	-	-	-	-	-	-	-	-	15	-	-
Polvere C	-	-	54	-	-	-	-	50	-	-	54	50
Polvere Dupont	-	-	-	-	-	-	-	-	-	10	20	40
TNT	-	10	-	-	10	-	4	10	10	10	-	10
Am nitrate	55	64	-	-	70	80	55	-	-	60	-	-
K nitrate	-	-	-	40	-	-	5	40	40	-	-	-
Na nitrate	-	9	26	-	-	-	20	-	-	-	26	-
Am chlorate	-	-	20	-	-	-	-	-	-	-	-	-
K perchlorate	-	-	-	-	5.5	10	5	-	-	-	-	-
Woodflour	-	-	-	-	4.5	-	1	-	-	-	-	-
Ca silicide	-	5	-	-	-	-	-	-	-	5	-	-
Trauzl test	430	425	445	315	320	330	350	350	375	410	435	435
Gap test, Cm	-	1	7	-	4	4	1	1	1	1	3	4
Veloc. of deton. m/sec	-	-	-	-	3300	3200	1350	1500	1320	2500	2328	2900

Esplosivo da mina polverulento seuza nitroglicerina — DYNAMITE

Pulverulent mining explosives without Nitroglycerin are listed by C. Belgrano, "Gli Esplosivi", Hoepli, Milano (1952). Some examples of the 80 such compositions are given here:

Composition(%) and Some Properties	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Am nitrate	85.5	77.0	40.0	78.0	82.0	80.0	79.5	70.0	84.5	90.0	-	79.0	70.0	63.0
Dinitronaphthalene	-	-	-	-	-	-	-	5.0	10.0	-	-	-	-	-
Dinitrotoluene	-	-	-	-	1.0	-	-	-	-	-	-	-	-	-
Trinitrotoluene	4.5	15.0	-	16.0	14.0	20.0	10.0	10.0	-	8.0	90.0	-	-	-
Am perchlorate	-	-	25.0	-	-	-	-	-	-	-	-	-	-	-
K perchlorate	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K nitrate	-	-	29.0	-	-	-	-	-	-	-	-	-	-	-
Woodflour	10.0	6.5	4.0	-	3.0	-	2.5	-	-	2.0	-	1.0	-	3.0
Oil	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-
Paraffin	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Na nitrate	-	-	-	4.5	-	-	8.0	15.0	-	-	-	-	-	13.0
K bichromate	-	-	-	-	-	-	-	-	4.5	-	-	-	-	-
Carbon (pulverized)	-	1.5	-	-	-	-	-	-	1.0	-	-	-	-	-
Charcoal (pulverized)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PETN or RDX	-	-	-	-	-	-	-	-	-	-	10.0	20.0	30.0	21.0
Ca carbonate	-	-	-	1.0	-	-	-	-	-	-	-	-	-	-
Ocher (hematite)	-	-	-	0.5		-	-	-	-	-	-	-	-	-
Trauzl test, cc	330	330	350	400	420	430	450	360	395	375	400	425	450	480
Gap test, cm	1	2	3	6	6	7	7	2	3	1	4	5	3	6
Veloc. of deton. m/sec.	1900	2300	2400	3600	3700	4300	3500	1600	3100	2300	7000	2850	2100	3000

Esplosivo FNP — FNP ESPLOSIVO

See Esanitrodifenilammina

Esplosivo P — CHEDDITE

A blasting explosive consisting of Ammonium Perchlorate 61.5%, sodium nitrate 30% & paraffin 8.5%.

A similar composition called Esplosivo speciale consists of Ammonium perchlorate 53%, sodium nitrate 35% & paraffin 12%.

See Explosive P under French Explosives.

Esplosivo plastico — ESPLOSIVO PLASTICO

A plastic explosive suitable for military use consists of: RDX 85-89%, petrolatum 12-10%, plastic binder (Tioplasto molle) 2-0.5% & glycerophthalic resin 1-0.5%. This explosive can be modified by incorporating aluminum powder into the mixture to give the following composition: RDX 64-75%, petrolatum 10-12%, plastic binder 0.5-2%, glycerophthalic resin 0.5-1% & aluminum powder 25-10%. [Ref: Dinamite Nobel Società Anonima at Milano, Italian Patent 427535 (24 November 1947) & 439931 (4 October 1948) and Chemical Abstracts 43, 7688 (1949) & 44, 6130 (1950)].

See also T4 (plastico).

Esplosivo S — CHEDDITE

A Cheddite-type blasting explosive consisting of Sodium Chlorate 90%, paraffin 7% & vaseline 3%.

Esplosivo S20 — ESPLOSIVO S20

A main explosive charge consisting of Ammonium Nitrate 79%, TNT 20% & woodflour 1%. It is manufactured by the Società Stacchini. L. Médard & A. LeRoux [Mémorial des Poudres 34, 201 (1952)] report that the composition and properties of this explosive are similar to those of the French Explosif du type N n° 0 which consists of Ammonium Nitrate 78.7% & TNT 21.3%. The properties of these two explosives are reported as follows:

Esplosivo S20 (cont'd)

	Esplosivo S20	Explosif N^{o} 0
Trauzl test (French Modification) Picric Acid = 100	118-119	119-120
Sensitivity to initiation (gms of Mercury Fulminate required to initiate material at density 1.05 gm/cc)	0.20	0.30
Gap test (French Modification) (distance in cm between cartridges at a density of 1.05 gm/cc)	6.5	7.0
Velocity of detonation, meters/sec (cartridges loaded at a density of 1.10 gm/cc)	4100	5000

Esplosivo speciale — CHEDDITE

See Esplosivo P.

Exil, Esanitrodifenilammina or p-Dipicrilammina — HEXANITRODIPHENYLAMINE

See Esanitrodifenilammina .

Exogene, T4 or Trimetilentrinitroammina — RDX

See T4.

FNP Esplosivo — FNP ESPLOSIVO

A high explosive composition consisting of Ammonium Nitrate 75%, PETN 20% & wax 5%. This mixture was used during WW II press loaded into some projectiles.

Fulmicotone or Cotone Fulminante — GUNCOTTON

Fulminato d'argento — SILVER FULMINATE

It is used in small quantities by the Italian Navy.

Fulminato di mercurio — MERCURY FULMINATE

It was manufactured during WW II by the Nobel Società Generale di Esplosivi e Munizioni at Tiana and by the Società Anonima Bombrini Parodi-Delfino at Colloferro-Roma. The usual form consists of small diamond-shaped crystals of 0.2-mm maximum length. It is used in admixture with antimony sulfide & Potassium Chlorate in Primers. Some mixtures also contain powdered glass. Another variety of Mercury Fulminate used for special purposes (unspecified) is prepared by finely grinding it under water with porcelain balls in a porcelain ball mill.

Gelatina 40% — GELATIN DYNAMITE

See Dinamite.

Gelatina 65% (Ammon dinamite) — AMMONIUM NITRATE GELATIN

See Dinamite.

Gelatina dinamite — GELATIN DYNAMITE

See Dinamite.

Gelatina dinamite incongelabile (or antigelo) — GELATIN DYNAMITE

See Dinamite.

Gelatina esplodente or Gelatina gomma — BLASTING GELATIN

See Dinamite.

Gelatina esplosiva da guerra — GELATIN DYNAMITE

See Dinamite.

Gelatina gomma or Gelatina esplodente — BLASTING GELATIN

See Dinamite.

Gelatina Vender — GELATIN DYNAMITE

See Dinamite.

Gelignite — GELATIN DYNAMITE

A blasting explosive consisting of Nitroglycerin 59%, Collodion Cotton 4%, potassium nitrate 29% & woodflour 8%. Another mixture called Gelignite all'ammonio consists of Ammonium Nitrate 70%, Collodion Cotton 0.70% & Nitroglycerin 29.30%. Gelignite was used during WW II as a bursting charge in Land Mines, such as railroad mines & wooden box anti-tank mines.

Gomma A & B — GELATIN DYNAMITE

See Esplosivo da mina gelatinoso con nitroglicerina.

Gomma incongelabile — GELATIN DYNAMITE

A non-freezing Gelatin Dynamite consisting of Nitroglycerin 65-72%, liquid TNT 7-8%, Collodion Cotton 5-6% & Ammonium Nitrate 15-22%, and manufactured by the Nobel Società Generale di Esplosivi e Munizioni, Dinamitificio at Orbetello.

Idrolita — IDROLITA

A high explosive composition consisting of Ammonium Nitrate 70%, RDX 20%, paraffin 3% & water 7%. This explosive is claimed to be stable & insensitive to shock. It was manufactured by the Società Dinamite Nobel at Avigliana.

Imperialite — AMMONIUM NITRATE DYNAMITE, IMPERIALITE

A blasting explosive composition consisting of Ammonium Nitrate 85-90% & aluminum scales 15-10%. The inventor of this mixture was killed in a violent explosion of the composition.

Incendiarie (Miscele) — INCENDIARY COMPOSITIONS

Some Incendiary mixtures used in Bombs and patented after WW II include:

a) TNT (PETN or RDX) 15-60%, oxidizers (such as chlorates, nitrates, oxides, perchlorates & peroxides) 20-40% & finely pulverized metals (such as aluminum, magnesium, zinc or iron) 20-40% [Ref: Bombrini Parodi-Delfino, Italian Patent 43093 (23 Feb 1948) & Chemical Abstracts 43, 8682 (1949)].

Incendiarie (cont'd)

b) Potassium Chlorate 50%, Ammonium Nitrate 20%, magnesium 20% & anhydrous copper sulfate 10%. The magnesium powder may be replaced in part by aluminum powder. This mixture is ignited by a few drops of water, but in the presence of moist air it weathers slowly without heating. It can be compressed. [Ref: Ministero della difesa marina & M. Tonegutti, Italian Patent 446010 (8 March 1949) & Chemical Abstracts 45, 1770 (1951)].

c) Ferric oxide 43%, barium peroxide 11.5%, celluloid 20%, aluminum 17%, sodium silicate 6.5% & bitumen (rosin, tar or other substance to regulate combustion) 2%. This mixture can be heated at 100°C and compressed at 5,000-6,000 atmospheres without danger. [Ref: Ministero della difesa aeronautica, Italian Patent 448101 (10 May 1949) & Chemical Abstracts 45, 1770 (1951)].

MABT — MABT

A high-explosive composition consisting of Picric Acid, TNT & dinitrophenol. It is prepared by mixing MAT & MBT. This mixture melts at 65-70°C. It is used as a bursting charge in ordnance ammunition.

Manlianite — MANLIANITE

A Cheddite-type explosive consisting of Ammonium Perchlorate 72%, carbon 14.7% & sulfur 13.3%. It is one of several explosives proposed by U. Alvisi.

MAT — MAT ; PICRATOL

A castable high-explosive mixture of Picric Acid 60% & TNT 40%. It is a yellow-buff solid which on heating becomes plastic at 55°C and melts at 85°C. Its properties are reported as follows: Ballistic strength 103% (TNT = 100%); brisance by sand test - 44 gm sand crushed vs 43 gm for TNT; explosion temperature 240-280°C; impact sensitivity with 2 kg weight 13 inches vs 14 inches for TNT; rifle bullet sensitivity - 10% detonations from impact of a .30-caliber bullet fired at a distance of 90 feet; stability - stable in storage; toxicity - less toxic than straight TNT; and velocity of detonation 7100 meters/sec vs 6900 meters/sec for TNT.

This explosive is used for cast loading medium-caliber shells.

MBT — MBT

A castable mixture of Picric Acid 60% & Dinitrophenol 40%. It is a yellow solid which, when heated, becomes plastic at 68°C and melts at 77°C. Its cast density is 1.65 gm/cc; less powerful & less brisant than TNT; and requires a strong initiator for detonation. It is used to load medium-caliber Projectiles. See also TRIDITE, Chaōyaku under Japanese Explosives & DD (Explosif) under French Explosives.

Melinita — PICRIC ACID

See Acido picrico.

Metriolo, Nitrometriolo or Nitropentaglicerina — METRIOL TRINITRATE

A slightly turbid, oily liquid explosive invented by the Società Anonyma Bombrini Parodi-Delfino and manufactured at the Colloferro-Roma plant. It is obtained in 92% yield by nitrating trimethylolmethylmethane in a batch process using mixed nitric-sulfuric acid of zero water content. The process is similar to that used for the preparation of Nitroglycerin, except that higher ratios of acid are used in order to obtain more stable spent acid. The trimethylolmethylmethane is obtained by interaction of propylaldehyde & formaldehyde in water at ordinary temperature in the presence of lime, in the same manner as in the preparation of pentaerythritol.

Metriolo is used as an ingredient of smokeless powders. It is a good phlegmatizer for Nitrocellulose, but by itself it does not gelatinize Nitrocellulose except at temperatures of at least 110°C. However, when about 8% of "acetometriol" (metriol triacetate) is added, gelatinization takes place at 80°C. Advantages of Metriolo are low volatility, low calorific value (which means low erosion of gun barrels), and a good degree of flashlessness. The Italian Navy is greatly impressed by the considerably reduced flash of Metriolo Propellants.

MNDT or Siperite — SIPERITE

See Siperite.

MST or Nougat — NOUGAT

See Nougat.

Nitramite or Avigliana 3 — AMMONAL

An Ammonal-type explosive consisting of Ammonium Nitrate 72%, aluminum 22% & bitumen pitch (or paraffin) 6%. It is used as a bursting charge in all types of ammunition.

Nitrato ammonico or Nitrato d'ammonio — AMMONIUM NITRATE

Used in a wide variety of military & commercial explosives. See Afocite, Albite, Amatolo, Ammonal, Ammonite No. 1, ANS or Antisanzionite, ASN Esplosivo, Astralite, Cremonite, Dinamite, Dinamon, Echos or Escho, Esplosivo da mina, Esplosivo S20, FNP Esplosivo, Gelignite, Gomma incongelabile, Idrolita, Imperialite, Incendiare, Mining Explosives, under Nitrodiglicole, under Nitroguanidina, MST or Nougat, Nitrodiglicole esplosivo, PAN, PANA, PNP Esplosivo, Polvere "Cannel", Romite, Sabulite, Schneiderite, Siperite, Solfite, Umbrite, Unknown Name Explosives, Vibrite, Virite, and others.

Nitrocellulosa or Nitrocotone — NITROCELLULOSE

Nitrodiglicole or Nitroeterolo — DIETHYLENEGLYCOL DINITRATE

A colorless liquid explosive used as a component of propellants & composite explosives. The Italian Army Specification requirements listed in the pamphlet, "Capitolato Tecnico Generale per la Fornitura di Esplosivi Propellenti", MD Esercito (1951), CTF 28, are as follows: Nitrogen content 14.10%; alkalinity - expressed as % Na_2CO_3, 0.0023; and stability by 120°C German test (Stabilità al saggio Tedesco a 120°C) - red coloration of indicator paper, 30 minutes.

Two composite explosives employing Nitrodiglicole are known.

Mining Explosive: Nitrodiglicol 36.5%, Ammonium Nitrate 28.0%, sodium nitrate 24.0%, PETN 10.0% & Nitrocellulose 1.5%.

Plastic Explosive: Nitrodiglicol 32% & RDX 68%.

Nitrogelatina — GELATIN DYNAMITE

Nitroglicerina, Olio esplosivo or Trinitroglicerina — NITROGLYCERIN

An oily liquid explosive first prepared in a pure state in 1846-47 by Ascanio Sobrero, University of Torino, Italy. Although Sobrero recognized Nitroglycerin as a highly explosive substance, the first practical application of it was made not in Italy but in Sweden by A. Nobel who invented Dynamite & Ballistite.

The Italian Army Specification requirements are as follows: Nitrogen content (Titolo d'azoto) 18.36%; reaction (Reazione) - neutral to litmus; neutral to phenolphthalein; and stability by Abel test at 80°C (Stabilità al saggio Abel a 80°C) 14 minutes.

It is used in a number of military & commercial explosives such as Dinamite, Esplosivo da mina, Gelignite, Gomma incongelabile, Pentrinite, and others.

Nitroguanidina — NITROGUANIDINE

Its reported properties are: Heat of explosion 625 kcal/kg; temperature of explosion 900°C; volume of gas at standard temperature & pressure 1073 liters/kg; and specific pressure (forza) 7600 kg/sq meter. It was used during WW II as a component of Propellants, and in composite explosive main fillers called Albite & Umbrite. The following explosive compositions were proposed in 1939:

a) Nitroguanidine 28%, Ammonium Nitrate 70% & calcium silicide 2% - Trauzl test value 350 cc.

b) Nitroguanidine 28%, Ammonium Nitrate 68% & oil 4% - Trauzl test value 325 cc.

c) Nitroguanidine 19%, Ammonium Nitrate 76%, calcium silicide 5% - Trauzl test value 325 cc.

d) Nitroguanidine 15%, Ammonium Nitrate 50%, lead nitrate 30% & calcium silicide 5% - Trauzl test value 360 cc.

Nitrometriolo, Nitropentaglicerina or Metriolo — METRIOL TRINITRATE

See Metriolo.

Nitronaftita — NITRONAFTITA

According to F. Piantanida, Mémorial de l'Artillerie Française (Paris) 14, 459 (1935), it is a mixture of RDX 75-80% mononitronaphthalene 25-20%, manufactured by the Società Anonima Dir ite Nobel at Avigliana. This mixture softens at 70-80°C but does not melt. It must be press loaded into ammunition components.

C. Belgrano, "Gli Esplosivi", Hoepli, Milano (1952), page 138, reports that "le nitronaftiti" are mixtures of RDX (or PETN) & dinitronaphthalene.

All of these mixtures are sufficiently insensitive to be press loaded into ammunition components. They are more powerful than TNT.

Nitropentaglicerina — METRIOL TRINITRATE

See Metriolo.

Nougat or MST — NOUGAT

An Amatol-type explosive consisting of Ammonium Nitrate 50%, TNT 43% & dinitronaphthalene 7%. It is used cast loaded in the following projectiles: 120/21 mm HE; 120/21 mm HE (cast steel); 149/35 mm HE, M32/38; 149/13-35 mm HE (one piece); 149/35 mm HE (British); 210 mm HE (bomba); 305/17 mm HE (cast steel); and 305/17 mm HE (one piece).

Olio di sgocciolamento — DRIP OIL

A crude, commercial, oily substance resulting from the two-stage nitration of toluene in the manufacture of TNT. Its main constituents are isomers of DNT with small quantities of various isomers of TNT & other nitro compounds. This substance is similar to American "drip oil", German "Tropföl" & French "huille".

It is used as an ingredient of non-freezing Dynamites (Dinamti incongelabili), of some Ammonium Nitrate explosives, and as a gelatinizer of Nitrocellulose for Propellants. Due to the fact that its composition is variable and it contains some sulfuric acid derivatives, its use in military explosives is not recommended. Another method of utilizing drip oil is to nitrate it, separately from purified DNT, to the tri-stage. This gives a product nearly as powerful as TNT but of inferior stability.

Olio di sgocciolamento (cont'd)

A typical commercial explosive consists of Olio di sgocciolamento 16%, TNT 7%, Ammonium Nitrate 45%, sodium nitrate 15%, potassium perchlorate 16.5% & Collodion Cotton 0.5%.

Olio esplosivo, Nitroglicerina or Trinitroglicerina — NITROGLYCERIN

See Nitroglicerina.

Ossonite — OSSONITE

A liquid mining explosive consisting of Picric Acid, concentrated nitric acid & liquid nitrogen peroxide. The components of this explosive are mixed in situ just before use.

PA (Pentrite - Acetato di pentaeritrate) — PA

An explosive mixture of PETN & pentaerythritol tetra acetate (PETA) developed by Bombrini Parodi Delfino (BPD), Colleferro near Rome. Two compositions PETN/PETA 65/35 & 75/25, melting at 84-88°C, were developed and proposed as bursting charges. These mixtures are fairly insensitive to shock. They have the same power as TNT, but are reported to be seldom used as they are more expensive than TNT.

PAN (PA-Nitrato d'ammonio) — PAN

An explosive mixture of PA & Ammonium Nitrate developed by BPD (see above). It is reported to have the same power as 80/20 Amatol but more expensive.

PANA (PAN-Alluminio) — PANA

A high explosive mixture of PAN & aluminum developed by BPD (see above). This mixture is more powerful than Ammonal (Ammonium Nitrate/TNT/aluminum) but, being more expensive, is seldom used.

Pentrinite — PENTRINITE

Mixtures of PETN 80-85% & Nitroglycerin 20-15%, invented by A. Stettbacher, Swiss scientist. Such mixtures are very powerful explosives. [Ref: E. Piantanida, Mémorial de l'Artillerie Française (Paris) 14, 458 (1935)]. See also under Swiss Explosives.

Pentrite, Tetranitrato di Pentaeritrite or Tetranitropentaeritrite — PETN

The PETN used in Italian explosives is subjected to the following tests:

Acidity (Acidità) - determined by titrating an acetonic solution with 0.01N sodium hydroxide solution in the presence of methyl red indicator.

Ash (Ceneri) - determined by weighing the residue of a sample heated in a muffle furnace at 600-700°C.

Bulk Density (Densità apparenta) - determined by weighing the contents of a cylinder of known volume, about 0.840 gm/cc.

Insoluble Matter (Materia insolubile) - determined by treating a 50-gm sample with 300-400 ml of acetone, 0.7% (maximum).

Moisture (Umidità) - determined by drying a 10-gm sample at 90°C.

Abel Test (Saggio Abel) at 80°C - 60 minutes (minimum).

German Test (Saggio Tedesco) at 120°C - 180 minutes (minimum).

Sieving Test (Setacciatura) - PETN for use in Detonators must pass thru a fine silk sieve.

Straight PETN was used during WW II as a burster charge in small-caliber shells (such as 20 mm) and as upper detonator & booster in small shells. When desensitized with 8-10% wax, it was dyed blue and used as a booster & bursting charge in Shells, and also pressed into blocks for use in Demolition Charges.

Some composite explosives containing PETN include ANS or Antisanzionite, ASN Esplosivo, Esplosivo da guerra, Esplosivo da mina, FNP Esplosivo, Idrolita, Incendiare, Nitronaftita, PA, PAN, PANA, Pentrinite, Pentritolo, Pentrol, PNP Esplosivo, Unknown Name Explosives, and others.

Pentritolo — PENTOLITE

Mixtures of PETN 50-80% & TNT 50-20% were used by the Italians as early as 1934, as bursting charges in Land Mines, Demolition Charges,

Pentritolo (cont'd)

and in some underwater Depth Charges. Pentritols are usually dyed red. Some of them are further phlegmatized by immersing in molten paraffin or by incorporating some mononitrotoluene in the mixture.

Pentrol — PENTOLITE

The 50/50 mixture of PETN & TNT reported to be used by both the Army & Navy as a castable bursting charge for military weapons.

Pertite — PICRIC ACID

See Acido picrico.

Picrato ammonico or Picrato d'ammonio — AMMONIUM PICRATE

There is no information on the use of Ammonium Picrate alone in Italian ammunition. Its use in a composite explosive called Cremonite (qv) is reported.

Piombite — PIOMBITE

An explosive composition consisting of lead nitrate 75%, calcium silicide 16%, lead carbonate (basic) 6.5%, trinitronaphthalene 1.5% & vaseline 1.0%. It is reported used during WW I as a bursting charge for cast-iron Grenades. A source published after WW II lists a composition by the same name as consisting of lead nitrate 76%, calcium silicide 5%, Trinitronaphthalene 16% & vaseline 3%. It is reported to be used as a mining explosive.

Pirotecnia or Artifizi da guerra — PYROTECHNICS

The following Italian military Pyrotechnic smoke compositions are given by J. Goldenson & C.E. Danner, Chemical & Engineering News 26, 1976-78 (1948):

Red - Potassium Chlorate 26%, lactose 27%, Sudan IV 27%, Rhodamine B 14%, Auromine 5% & sucrose 1%.

Yellow - Potassium Chlorate 30%, "Auromine O" 65% & kieselguhr 5%.

Pirotecnia or Artifizi da guerra (cont'd)

Green - Potassium Chlorate 27%, lactose 25%, dimethylaminoazobenzene 21% & 1, 4-di-p-toluidinoanthraquinone 27%.

Black - Potassium Chlorate 60%, naphthalene 20% & alpha-mononitronaphthalene 20%.

These compositions are used in colored smoke signal devices for air-to-air liaison.

Colonel Attillio Izzo, "Pirotecnia e Fuochi Artificiali", Hoepli, Milano (1950), describes various Italian military pyrotechnic devices used, lists various smoke-producing compositions, and gives the following pyrotechnic signal & star compositions:

Red light star - a) Potassium Chlorate 60%, strontium nitrate 25% & shellac 15%; b) Potassium Chlorate 40%, strontium nitrate 40%, charcoal 6%, lampblack 6% & tar 8%.

Red light signal - a) Potassium Chlorate 70%, strontium carbonate 15% & shellac 15%; b) Potassium Chlorate 30%, strontium nitrate 44%, sulfur 18%, charcoal 2% & antimony sulfide 6%.

Yellow light star - a) sodium nitrate 74%, aluminum 18% & sulfur 8%; b) Potassium Chlorate 40%, barium nitrate 23.5%, potassium nitrate 10.5%, shellac 12%, sodium bicarbonate 4.5%, charcoal 3.5% & dextrin (or gum arabic) 6%.

Yellow light signal - potassium nitrate 62.5%, sulfur 23%, sodium oxalate (or sodium nitrate) 10.5% & charcoal 4%.

Orange light star - Potassium Chlorate 70%, sodium bicarbonate 15%, shellac 1.5%, & sulfur 13.5%.

Green light star - a) barium nitrate 50%, Potassium Chlorate 35% & shellac 15%; b) Barium Chlorate 70%, lactose 13% & shellac 17%; c) barium nitrate 53%, Potassium Chlorate 30%, shellac 15% & lampblack 2%.

Green light signal - barium nitrate 53%, Potassium chlorate 31%, sulfur 10% & shellac 6%.

Blue light star - a) Potassium Chlorate 70%, ammoniacal copper sulfate 15% & shellac 15%; b) Potassium Chlorate 59%, Schweinfurth green 31%, anthracene 6.5%, lactose 2% & methylcellulose 1.5%; c) Potassium Chlorate 67%, Paris green 20%, shellac 10%, dextrin (or gum arabic) 3%.

Pirotecnia or Artifizi da guerra (cont'd)

Blue light signal - a) Potassium Chlorate 54.5%, ammoniacal copper sulfate 27.5% & charcoal 18%; b) Potassium Chlorate 53%, ammoniacal copper nitrate 26%, charcoal 16% & sulfur 5%.

Pink light star - Potassium Chlorate 58%, strontium carbonate 22% & shellac 20%.

Violet light star - Potassium Chlorate 58.5%, Strontium Chlorate 14.5%, copper carbonate 10%, sulfur 10% & shellac 7%.

White light star - a) potassium nitrate 65%, sulfur 19% & antimony sulfide 16%; b) potassium nitrate 60%, iron filings (paraffined) 16%, charcoal 8%, Black Powder (meal) 8% & dextrin (or gum arabic) 8%; c) potassium nitrate 50%, Black Powder (meal) 31% & zinc filings 19%; d) potassium nitrate 80%, sulfur 10% & red arsenic 10%; e) potassium nitrate 49%, Black Powder (meal) 18%, antimony powder 18% & sulfur 15%; f) Potassium Perchlorate 61%, aluminum powder 31% & lycopodium powder 8%

White light signal - a) potassium nitrate 52%, sulfur 22%, Black Powder (meal) 22% & antimony trisulfide 4%; b) potassium nitrate 75%, sulfur 23% & charcoal 2%; c) potassium nitrate 61%, sulfur 19%, Black Powder (meal) 5% & antimony trisulfide 15%; d) potassium nitrate 33%, barium nitrate 45%, sulfur 11% & shellac 11%.

Whistling mixtures (miscele sibilanti) are listed by Izzo as follows: a) Potassium Picrate 70% & potassium nitrate 30%; b) Potassium Chlorate 75% & gallic acid 25%; c) Potassium Chlorate 50% & gallic acid 50%.

A number of Smoke Producing compositions (composizioni per miscele fumogene) are also listed by Izzo.

The principal factories manufacturing Italian Pyrotechnics are: Polverifici Stacchini di Roma, Polverifici di Como, la Mugnaioni & la Società ACNA di Cengio.

PNP Esplosivo — PNP ESPLOSIVO

A press-loaded explosive mixture consisting of Ammonium Nitrate 75%, PETN 20% & wax 5%. It is used as a bursting charge in various Projectiles.

Polvere bruna or Polvere cioccolata — BROWN POWDER

A Brown Powder or Chocolate Powder consisting of potassium nitrate 79%, incompletely carbonized wood 18% & sulfur 3%. It is used as a substitute for Black Powder.

Polvere "Cannel" — CHEDDITE

A Cheddite-type explosive consisting of Ammonium Nitrate 80% & Cannel coal from Scotland 20%. It was proposed by Ugo Alvisi for use as a blasting explosive.

Polvere da mina or Esplosivo da mina — DYNAMITE

Polvere nera or Polvere da fuoco (Fire Powder) — BLACK POWDER

The types & compositions used in Italy are as follows:

Tipo da guerra (Military type) - potassium nitrate 75%, carbon 12.5% & sulfur 12.5%.

Tipo da caccia (Hunting or Sporting type) - potassium nitrate 75-78%, carbon 15-12% & sulfur 10%.

Tipo da mina (Mining or Blasting type) - potassium nitrate 62-70%, carbon 20-12% & sulfur 18%.

The properties of the Military-type powder are reported as follows: Density 1.7 gm/cc (maximum); explosion temperature 300°C; force 3250 kg/sq meter; impact sensitivity with 2 kg weight - 70 cm; temperature developed on explosion 2700°C; Trauzl test 180 cc; velocity of detonation 1400 m/sec; and volume of gases, at standard temperature & pressure, developed on explosion 325 liters/kg.

It is used as the Igniter in percussion-type primers. For example, the Igniter of the 105/28 mm cartridge case contains 25-30 gm of Black Powder & about 5 gm of lead foil (a decoppering agent).

Polvere verde | CHEDDITE

A green, Cheddite-type explosive consisting of Potassium Chlorate 66.7%, Picric Acid 19.0% & potassium ferrocyanide 14.3%. It is used in blasting operations.

Romite | CHEDDITE

A Cheddite-type explosive consisting of Ammonium Nitrate 49%, Potassium Chlorate 39% & naphthalene (or paraffin) 12%. It was used during WW II as a bursting charge in Land Mines.

Sabulite | SABULITE

A permissible Ammonium Nitrate Dynamite originally developed in Belgium. Its typical composition is Ammonium Nitrate 54%, potassium nitrate 22%, ammonium chloride 13%, TNT 6% & calcium silicide 5%. The Italians modified the composition to an Ammonal-type explosive in which TNT is replaced by Trinitronaphthalene.

Some compositions used as a bursting charge are as follows:

Sabulite of WW I - Ammonium Nitrate 78%, calcium silicide 14% & TNT 8%.

Sabulite ordinary - Ammonium Nitrate 60%, sodium nitrate 18%, calcium silicide 14% & Trinitronaphthalene 8%.

Sabulite special - Ammonium Nitrate 65%, calcium silicide 25% & Trinitronaphthalene 10%.

Sabulite 18 - Ammonium Nitrate 42%, sodium nitrate 40% & Trinitronaphthalene 18%.

See also under Belgian Explosives.

Schneiderite | SCHNEIDERITE

An explosive similar to French Schneiderite & Russian Shneiderit. Its composition is Ammonium Nitrate 87.4% & dinitronaphthalene 12.6%. It is used for cast loading some Shells and as a Demolition Charge.

Some sources do not distinguish between Schneiderite & Siperite (qv).

Siperite or MNDT — SIPERITE

An explosive composition consisting of Ammonium Nitrate 82-87% & dinitronaphthalene 18-13% to which 20% TNT is added. Some sources report its composition as Ammonium Nitrate 72.8%, dinitronaphthalene 10.5% & TNT 16.7%. It is cast loaded as a bursting charge for some Projectiles.

Solfite — SOLFITE

An inexpensive explosive, proposed in 1930 by Dr. Pannoncini, consisting of Ammonium Nitrate 83-88% & sulfur 17-12%. Its intended uses are not reported.

Stifnato di piombo or Trinitro resorcinato di piombo — LEAD STYPHNATE

See Trinitroresorcinato di piombo.

T4, Trimetilentrinitroammina or Exogene — RDX

The properties of straight T4 are as follows: explosion temperature 230°C; heat of explosion 1390 kcal/kg; temperature developed on explosion 3380°C; volume of gases, at normal temperature & pressure, developed on explosion 890 liters/kg; and specific pressure (forza) 10,600 kg/sq meter. C. Belgrano, "Gli Esplosivi", Hoepli, Milano (1952), page 135, also compares the properties of straight T4 with those of T4 desensitized by paraffin. The properties of Tritolo (TNT) are given as a standard.

	Straight		T4 Phlegmatized with Paraffin			
	TNT	T4	5%	10%	18%	20%
Velocity of detonation, meters/sec	6879	8330	8550	8300	8235	8020
Density at maximum	1.59	1.68	1.64	1.62	1.56	1.51
Velocity of detonation, meters/sec	6380	7740	7680	7725	-	-
Density (small)	1.45	1.50	1.50	1.49	-	-
Impact sensitivity with 2 kg weight, cm	110	30	150	190	190	190
Trauzl test value, cc	372	480	425	400	355	212

T4, Trimetilentrinitroammina or Exogene (cont'd)

T4, by itself, is too sensitive to be used as a burster charge in ammunition, but it is suitable for use in Detonators & Exploders. When so used, T4 is dissolved in cold acetone and precipitated by adding cold water to the solution. After filtering, the T4 is dried in an aluminum-jacketed rotating drum thru which air, heated to 125°C, is driven. The crystallized T4 is graphited (1%) to facilitate its press loading into Detonators.

In a slightly desensitized form, as for example 95/5 - T4/wax or paraffin, it is used as a Booster charge in ammunition.

As a bursting charge, mixtures of T4 & TNT, called Tritolite (qv), and mixtures of T4/TNT/Aluminum, called Tritolital (qv), are used. Another mixture consisting of Ammonium Nitrate 73.4%, T4 22% & wax 4.6% was used during WW II as a bursting charge for some armor-piercing, long-nose Shells.

See also Esplosivo da guerra, Esplosivo da mina, Esplosivo plastico, Idrolita, T4 (plastico) and under Unknown Name Explosives.

T4 (plastico) — COMPOSITION C

Wet purified T4 is aspirated on a filter and charged into a stainless steel jacketed vessel. Then 4% of petrolatum, calculated on the dry weight of T4, is added and the mixture stirred for 3 hours at 95°C. This operation reduces the moisture content to below 0.5%. The contents are transferred to a planetary mixer jacket cooled to about 20°C. The resulting fine powder is incorporated for 4-5 hours with other ingredients in a Werner-Pfleiderer mixer to form a plastic explosive.

One such mixture contains T4 78.5%, Diethyleneglycoldinitrate (0.3 - 0.4% Collodion Cotton) 17.5% & vaseline 4%. This mixture is called "Italian " and supersedes the so-called "American " mixture consisting of T4 84%, petrolatum 15% & carbon black (added) 1%. This latter mixture was found to harden in storage. Another mixture consists of T4 89% & petrolatum 11%. Its properties are density 1.58 gm/cc and velocity of detonation 8000 meters/sec. It is used in Land Mines & in antitank Bombs. One mixture is reported to consist of T4, Tetryl, Nitrocellulose & a plasticizer. It is water resistant and can be used as a bursting charge in underwater ordnance.

See also Esplosivo da guerra & Esplosivo plastico.

Tetralite, Tetrile, Tetranitro-metilanilina or Trinitrofenilmetilnitroammina — TETRYL

Its properties are reported as follows: mp 129°C; density 1.725 gm/cc; impact sensitivity with 2-kg weight - 30 cm; Trauzl test value 340 cc; and velocity of detonation 7250 meters/sec.

It is used as a component of some explosive mixtures, such as with TNT, but there is no information that it was used as a booster charge.

Tetranitropentaeritrite — PETN

See Pentrite.

Tipo I & II dinamite — DYNAMITE

See Dinamite.

Tolite — TNT

See Tritolo.

Toluol-ammonal — AMMONAL

See Ammonal.

Trialen 105 — TRIALEN

A castable high explosive composition consisting of TNT 50%, RDX 25% & aluminum 25%. This mixture is used in Torpedoes & other underwater ordnance.

See Tritolital, and also Trialen under German Explosives.

Trilite — TNT

See Tritolo.

Trimetilentrinitroammina — RDX

See T4.

Trinitroanisolo TRINITROANISOLE

In Italy studies were made of this compound in regard to its use in mining explosives. One such mixture consists of Ammonium Nitrate 80% & Trinitroanisole 20%. Its Trauzl test value is 420 cc and gap test 2 cm. Incorporation of some TNT in this mixture increases its brisance.

It was used in France, Germany & Japan for military purposes.

Trinitrofenilmetilnitroammina TETRYL

See Tetralite.

Trinitrofenolo PICRIC ACID

See Acido picrico.

Trinitroglicerina NITROGLYCERIN

See Nitroglicerina.

Trinitro-meta-cresolo CRESYLITE

See Cresilite.

Trinitroresorcina STYPHNIC ACID

See Acido stifnico.

Trinitroresorcinato di piombo LEAD STYPHNATE

The Società Nobel at their T ana plant near Torino manufactured this compound in the same apparatus they used for the preparation of Lead Azide (Acido di piombo). An 8% solution of Styphnic Acid (Trinitroresorcina) is treated with 0.2% magnesium oxide and a 25-30% solution of lead nitrate at a temperature of 60°C. The resulting precipitate is filtered, washed & dried in the same manner as Lead Azide, except no phlegmatizer is used. The Lead Styphnate is stored in containers made of electrolytically oxidized aluminum, because metallic aluminum is attacked by Lead Styphnate. The purified product consists of single prismatic crystals of the same dimensions (0.2-mm diameter) as Lead Azide.

It is used as an igniting charge for Lead Azide and as an ingredient of Priming Compositions.

Trinitrotolueno, Trinitrotoluolo or Trinolo — TNT

See Tritolo.

Tritolital — TORPEX

A military explosive composition consisting of TNT 60%, RDX 20% & aluminum 20%. Its brisance by Italian steel plate test (prova della piastra di acciaio) is 21 mm, Trauzl test value 425 cc and velocity of detonation 7400 meters/sec. This composition was used during WW II as a castable bursting charge in underwater weapons, such as Torpedoes, Sea Mines & Depth Charges.

See also Trialen 105.

Tritolite — COMPOSITION B

Mixtures of T4 (RDX) & TNT (Tritolo) were proposed in 1930 by M. Tonegutti for use in underwater weapons, such as Torpedoes, Sea Mines & Depth Charges. The original mixture contained 50% RDX & 50% TNT. Its properties are: Cast density 1.64 gm/cc; Trauzl test value 440 cc; brisance by Italian steel plate test 23 mm; and velocity of detonation 6500 meters/sec. The 40/60 RDX/TNT mixture has the following properties: Cast density 1.62 gm /cc; Trauzl test value 450 cc; brisance by Italian steel plate test 21 mm; and velocity of detonation 6600 meters/sec. Some RDX/TNT mixtures contain wax (see under T4) while others contain aluminum (see Tritolital).

These mixtures were used extensively during WW II in shaped-charge Projectiles and in Land Mines:

a) 50/50 RDX/TNT (Cyclotol)
b) 60/38/2 RDX/TNT/wax (dyed red) (Composition B)
c) 25/50/25 RDX/TNT/aluminum (Trialen 105)
d) 20/60/20 RDX/TNT/aluminum (Torpex)

The following method of manufacturing Tritolite was used at the Avigliana plant of the Società Dinamite Nobel. Wet purified T4 (RDX) after being aspirated on a filter is charged into a stainless steel jacketed vessel and 5% paraffin (calculated on the dry weight of RDX) is added. The mixture is stirred for 3 hours at 90-95°C in order to reduce the moisture content below 0.5%. The contents are transferred to a planetary mixture, water cooled to 20°C. This phlegmatized product

Tritolite (cont'd)

(in the form of a fine powder) is added gradually to the desired amount of molten TNT at about 90°C. After thoroughly mixing the ingredients, the paraffin, which floats to the surface, is skimmed off. Another method of preparing Tritolite is to dissolve RDX & TNT in acetone and then precipitate the mixed crystals by adding cold water.

Tritolo, Trilite, Trotyl, Tolite, Trinolo, Trinitrotolueno or Trinitrotoluolo — TNT

There is nothing original or unusual about the current method of manufacturing TNT. It is prepared in two grades:

a) AP (alto punto) - with mp 80-80.5°C.

b) BP (basso punto) - with mp 78-79°C.

The properties of both grades are as follows: Impact sensitivity with a 2-kg weight - 110 cm; Trauzl test value 372 cc; and velocity of detonation 6879 meters/sec at density 1.59 gm/cc.

Straight TNT is used by the Italians to a much lesser extent than by the Americans or British. This is probably due to the shortage of toluene, the starting material for its preparation. Pressed TNT is used as a booster in some Bombs and as a main filler for some Demolition Charges. Granular TNT is used as the bursting charge in Hand Grenades, Mortar Grenades & Land Mines. Cast TNT is used as the bursting charge for some Bombs, 2 kg - 1000 kg in weight, and for Shells, 57 mm to 420 mm.

TNT is also used extensively in composite explosives, such as Amatol, Ammonal, Dinamon, Esplosivo da guerra, Esplosivo da mina, Esplosivo S20, Gomma incongelabile, MABT, MAT, Nougat or MST, Pentritolo, Pentrol, Siperite or MNDT, Trialen 105, Tritolital, Tritolite, and others.

Umbrite — UMBRITE

A main high-explosive composition consisting of Nitroguanidine 48.4 - 45.1%, Ammonium Nitrate 37.3 - 41.4% & ferrosilicon 14.3 - 13.5%. It is used as a bursting charge in some Projectiles.

Unknown Name Explosives: ITALIAN UNKNOWN NAME EXPLOSIVES

a) A castable, burster-type explosive, patented by M. Tonegutti in 1938, consisting of Ammonium Nitrate 70%, PETN 20% & cyanoguanidine 10%. [Ref: M. Tonegutti, French Patent 833729 (1938) & Chemical Abstracts 33, 3590 (1939)].

b) A press-loaded explosive consisting of Ammonium Nitrate 73.4%, RDX 22% & wax 4.6%. This composition was used during WW II as a bursting charge for 47-mm Armor-Piercing Shells. It is similar in properties to 80/20 Amatol, except it is more sensitive to impact.

c) A press-loaded explosive consisting of RDX 95% & wax (dyed red) 5%. It is used as a booster charge in ammunition.

d) A cast-loaded explosive filler consisting of PETN 65% & pentaerythritol tetraacetate 35%. It is a substitute bursting charge used during WW II as a filler for 500-kg Time Bombs. This mixture is as insensitive to mechanical shock as TNT but about 25% less brisant.

Vibrite VIBRITE

An explosive composition consisting of Ammonium Nitrate 78%, calcium silicide 14% & Trinitronaphthalene 8%. It is used in blasting operations.

See also Sabulite.

Victorite CHEDDITE

A Cheddite-type explosive consisting of Potassium Chlorate 40.0%, Picric Acid 53.2%, potassium (sodium or barium) nitrate 4.8% & carbon 2.0%.

Virite BLACK POWDER

A Black Powder-type explosive consisting of potassium nitrate 33-38%, Ammonium Nitrate 35-40%, ammonium oxalate 9-12%, carbon 10-12% & sulfur 4-5%.

Wetter dinamite DYNAMITE

See under Dinamite.

Unusual Research & Development in the Field of Explosives

"Behavior of Explosives Under the Action of Gamma Rays"

In addition to previous studies when Propellants, used for ballistic & missile launchings, were exposed to Gamma Rays, this study now has been extended to include bursting-type (high) explosives. Explosives from three different categories of chemical compounds: aromatic nitroderivatives, nitric esters & nitramines, were exposed to the radiation from a cobalt 60 source. Specifically, these explosives are:

a) 2, 4, 6- Trinitrophenol (Picric Acid).

b) 2, 4, 6- Trinitrotoluene (TNT).

c) Pentaerythritol Tetranitrate (PETN).

d) Phlegmatized PETN.

e) Cyclotrimethylenetrinitramine (RDX).

The effects induced by Gamma Rays are deduced from variations in the chemical stabilities & in the fusion points of the explosives.

Samples of the five explosives were exposed to irradiation of an intensity of 3×10^4 roentgens per hour, administering doses between 0.5 - 20 megaroentgens, and with total exposure times from 15-660 hours.

From the experimental results obtained, it was concluded that:

1. The aromatic nitroderavitive explosives (Picric Acid & TNT) show no drop in chemical stability, even after the highest dose (20 megaroentgens), and from their behavior, it is inferred that they should be resistant to considerably higher doses.

2. The nitric ester explosive (PETN) shows a notable lowering of chemical stability with relatively small doses of Gamma radiation, doses of the order of 3 megaroentgens being sufficient to reduce its stability to zero. PETN phlegmatized with paraffin shows a distinctly higher resistance; in fact there is evidence of definite stability even with doses of 20 megaroentgens.

3. The nitramine explosive (RDX), while not showing the extremely high resistance of Picric Acid & TNT, resists quite well even doses of 20 megaroentgens. Below doses of 5 megaroentgens, the chemical stability of RDX is quite high.

The difference in resistance of the explosives to irradiation agrees with the different nature of their chemical bonds: between the nitric nitrogen & carbon in the benzene ring (aromatic nitroderivative); between the nitric nitrogen-oxygen & primary carbon (nitric ester); and between nitric nitrogen & nitrogen of the heterocyclic ring (nitramine). The high resistance of phlegmatized PETN, as compared with straight PETN, is evidence of the screening action of aliphatic hydrocarbons against Gamma radiation. This may indicate a way for protecting those explosives which, like Propellants, are especially sensitive to decreases in stability by aging after irradiation. It would thus be possible to assure a comparatively long shelf life for such explosives.

[Ref: E. Piantanida & M. Piazzi, Chimica e l'Industria (Milano) 42, 1238-42 (1960) & Chemical Abstracts 55, 20434 (1961) (Propellants); 43, 1389-93 (1961) & Chemical Abstracts 56, 10437 (1962) (High Explosives); latter paper Translated by US Joint Publication Research Service Technical Memorandum 1040 (September 1962)].

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Japanese Explosives

During WW II, the Japanese used a greater variety of high explosives and ammunition than other nations at the time. This was due to a shortage of raw materials necessary for the manufacture of the best explosives. Although they used many standard explosives (such as TNT, Picric Acid, PETN, RDX & Tetryl), every other available explosive substance was also used as an ingredient of explosive compositions. Among these substances may be mentioned the following: Trinitroanisole, Trinitrophenetole, Hexanitrodiphenylamine, Guanidine Nitrate, Dinitronaphthalene, Dinitrobenzene, Ammonium Picrate, as well as a number of commercial explosives, particularly Dynamites. As nonexplosive ingredients, the materials used included: inorganic nitrates, chlorates & perchlorates; aluminum, ferrosilicon, silicon carbide, petroleum, woodpulp (sawdust), powdered coal & charcoal, tars, waxes, oils and their combinations.

The Japanese initiating agents were similar to those used by the Germans, except that Tetracene was not used and fewer mixtures were employed in ammunition. Mercury Fulminate & Lead Azide were used in a few cases. While PETN was used extensively as a base charge for detonators, Tetryl was also used for this purpose. For priming compositions, the Japanese, like the Germans & Italians, used chiefly Mercury Fulminate. They did not appear to have used compositions based on Lead Styphnate and nonexplosive ingredient compositions.

As to Japanese ammunition itself, one can point out the great variety of improvised devices, such as Mines & Depth Charges made from wooden boxes, burlap bags with rubber lining & oil drums; Grenades made of pottery, glass & gas pipes; Booby Traps made of tin cans; and Bangalore Torpedoes made of bamboo tubes.

The principal explosives known to be used are listed alphabetically in the following pages.

A(ko), Type A(Explosive) or Otsu-B | A(KO)

A castable bursting charge consisting of TNT (or Trinitroanisole) 60%, Hexanitrodiphenylamine 24% & aluminum 16%. It is used as a replacement for the Type 94M and Type 97H Explosives (qv) in Mines, Torpedo Warheads & Depth Charges. This same composition is used by the Germans under the names Schiesswolle 18, NTD_2 & TSMV 1-101.

Ammonāru | AMMONAL

Specific uses are not known.

Ammonum Shosanen | AMMONIUM NITRATE

Used in a number of commercial & military explosives such as Ammonyaku, Ammonāru, Anbenyaku, Angayaku, "E" (Explosive), Keyaki, Kiri Nos 1, 2 & 3, Ko-Shoan Bakuyaku, Shin-Kiri, Shinkyoryoku, Shin-Toku-Shoan, Shoan Bakuyaku, Shoan Bakuyaku Nos 104 & 201, Shoanyaku, Shōbenyaku, Shonayaku, Shotoyaku, Type 4 Mk 2, and others.

There is also being conducted research on the use of Ammonium Nitrate in composition Propellants for Rocket Engines.

Ammonyaku | AMMONIUM NITRATE DYNAMITE

An explosive composition consisting of Ammonium Nitrate & charcoal. It is listed as a "substitute powder". Its uses are not known.

Anbenyaku or Shōbenyaku | ANBENYAKU

Main high-explosive burster charge consisting of Ammonium Nitrate 55% and Dinitrobenzene 45%. It was manufactured at Nanman Arsenal, Manchuria, under the name of Shōbenyaku. It was used during WW II in projectiles. An experimental mixture by the same names consisted of Trinitrobenzene, Ammonium Nitrate & Tetryl. No proportions or properties are given.

A blasting explosive, also called Anbenyaku, consisting of Ammonium Nitrate 71.7%, Nitroglycerin 8%, collodion cotton 0.3%, and powdered seaweed 20%, was patented in 1948 by T. Watanabe [Reference, Japanese Patent 176113 (1948) & Chemical Abstracts 45, 4930 (1951)].

Angayaku | ANGAYAKU

Several high-explosive compositions are known by this name. These consist of:

a) Ammonium Nitrate 75% and RDX 25%.

Angayaku (cont'd)

b) Ammonium Nitrate 78% and RDX 22%.

c) Ammonium Nitrate 84% and RDX 16%.

d) Ammonium Nitrate 51%, RDX 15% and Guanidine Nitrate 34%.

e) Ammonium Nitrate 48%, RDX 20% and Guanidine Nitrate 32%.

f) RDX 85% and wax 15%.

g) RDX 42%, PETN 50% and wax 8%.

All of the above compositions are white, nontoxic mixtures. They are comparable in performance to Amatols. Compositions a, b, and c are press-loaded fillers for Bombs; d and e are cast-loaded fillers for shells and Bombs. It is claimed that Compositions d and e have low coefficients of shrinkage and therefore can be poured in large casts in a single pour; whereas with similar explosives based on TNT, it is necessary to use several increments in pouring large casts. Composition f is used as a burster charge for Armor-Piercing Shells, and Composition g is used in machinegun Bullets. All of the above compositions were used during WW II.

Another composition, considered similar to US & British Torpex-type explosives, consists of Ammonium Nitrate 43.2%, Guanidine Nitrate 28.8%, RDX 8.0% & aluminum powder 20%. This explosive was manufactured at the Sankanoichi Factory of the Tokyo Army Arsenal No 2. There are conflicting reports as to cavitation in cast-loaded charges & other loading characteristics of this mixture. Its properties are not given. It was used to a limited extent in various types of underwater ammunition.

B4 (Incendiary) or Type 2(Explosive) — B4 (INCENDIARY)

A light-gray castable mixture of Trinitroanisole 60 to 70% & aluminum 40 to 30%. The properties of the 60/40 mixture are: cast density 1.90 gm/cc; brisance by copper cylinder crusher test 82% (Picric Acid = 100%); explosion temperature 300 to 500°C; impact sensitivity 17 cm with 5 kg weight (maximum cm for no explosions); friction sensitivity with 60 kg weight (maximum pressure for no explosions); and power by ballistic mortar 64% (Picric Acid = 100%). This explosive is used in Submarine-Gun Incendiary Shells.

Bakufun (Exploding Powder) — BAKUFUN

A light-gray to tan powder consisting of Mercury Fulminate 28.8%, Potassium Chlorate 37.7%, antimony sulfide 31.5% & abrasive 2%.

Bakufun (cont'd)

It is used in Primer Caps & Fuzes for 20-mm Ammunition. See also Raibun.

Bakubatsu-Sei Zeratin (or Zerachin) BLASTING GELATIN

Chakatsuyaku, Sanshōki Toruōru or Type 92 (Navy) TNT

A light-yellow to tea-brown explosive used straight, to a limited extent, in 25-& 40-mm Shells (Navy), in Grenades, Land Mines, Demolition Charges & in a few Bombs (Army).

It is also used in the following composite explosives: A(ko), Type A or Otsu-B; Chanayaku, Chaoyaku, Chauyaku, Nigotanoyaku Mk 2, Pentoriru, Seigata (Army) or Type 97H (Navy), Shoanyaku, Shōtoyaku, Tanoyaku, Type 92, Type 97H, and others.

Chanayaku — CHANAYAKU

A yellow castable mixture consisting of TNT 70% & dinitronaphthalene 30%. It is used for loading various Army Artillery Projectiles.

Chaōyaku — CHAŌYAKU

A cast- or press-loaded explosive mixture consisting of Picric Acid 75% & TNT 25%. Its melting point is below 120°C.; explosion temperature about 350°C.; relative brisance, power & rate of detonation are slightly lower than Picric Acid; and it is slightly less sensitive to friction than Picric Acid. It is used as a main filler in Navy Bombs.

Chauyaku — COMPOSITION B

A castable mixture of RDX 50% & TNT 50%. This composition is called Cyclotol in the US. It is used in various artillery projectiles. See also other mixtures of RDX & TNT called Nigotanoyaku, Mk 2.

Chikkaen (Navy) or Chikka Namari (Army) — LEAD AZIDE

It is used in various Detonators and Initiators for both Army & Navy ammunition.

Dainamaito — DYNAMITE

"E" (Explosive) — "E" (EXPLOSIVE)

A light-yellow castable filler consisting of Trinitroanisole 60% & Ammonium Nitrate 40%. Its cast density is 1.60 gm/cc; relative power as determined by ballistic mortar 108% (Picric Acid = 100%); impact sensitivity 1 g/cm (maximum cm for no explosions with 5 kg for no explosions). Its specific uses in ammunition are not known.

Ennayaku — CHEDDITE

A light-yellow explosive charge consisting of Potassium Chlorate 80%, mononitrotoluene 15% & castor oil 5%. This is a very sensitive

Ennayaku (cont'd)

mixture. It is used as a substitute Demolition Charge by the Army and as a substitute main charge for Hand Grenades & Mortars.

H_2 Kongo (H_2 Mixture) or Type 98 (Explosive) — H_2 KONGO

A lemon-yellow to greenish-yellow explosive composition consisting of Trinitroanisole 60 to 70% & Hexanitrodiphenylamine 40 to 30%. The 60/40 mixture is cast loaded to a density of 1.65 gm/cc; melting point 65 to 70°C; explosion temperature 264 to 490°C; brisance as determined by copper cylinder crusher method 100% (Picric Acid = 100%); relative power by ballistic mortar 96% (Picric Acid = 100%); rate of detonation by Dantriche method 7050 meters/sec; impact sensitivity 14 cm (maximum cm for no explosions with a 15 kg weight); and friction sensitivity 60 kg (maximum pressure in kg between two rubbing surfaces for no explosions).

Properties of the 70/30 mixture are: Explosion temperature 237 to 246°C; brisance by sand test 44 gm vs 43 gm for TNT; power by ballistic mortar 109% TNT; rifle bullet test 20% detonations; and impact sensitivity 12.5 inches vs 14 inches for TNT. This mixture is reported to be toxic, not very stable, and reactive with metals in the presence of moisture.

The 60/40 mixture is used in Navy Bombs, Depth Charges, Torpedoes & other ammunition in place of Picric Acid. The 70/30 mixture is used by Army & Navy as an Auxiliary Booster in some bombs & in some artillery projectiles.

Haensosan Bakuyaku or Type 88 (Ko) — JAPANESE TYPE EXPLOSIVES

See Type 88 Ko.

Haishokuyaku — HAISHOKUYAKU

A dark-gray pressed explosive composition. The No 1 mixture consists of Ammonium Perchlorate 77%, RDX 17%, silicon carbide 1.5%

Haishokuyaku (cont'd)

& paraffin 4.5%. Its relative brisance & power are greater than Picric Acid; and its sensitivities to impact & friction indicate a mixture less sensitive than Picric Acid. The No 2 mixture consists of Ammonium Perchlorate 48%, Guanidine Nitrate 20%, RDX 25%, graphite 2% & paraffin 5%.

The No 1 mixture is used in Army standard Demolition Blocks. The No 2 mixture is a commercial mining explosive and also used in military Demolition Blocks.

Karitto (Army) or Type 88 (Navy) — JAPANESE TYPE EXPLOSIVES

See Type 88 (Navy).

Kasshokuyaku — BROWN POWDER

Its uses are not known. Presumably it is used as a substitute for Black Powder.

Keineyaku — TRINITROPHENETOLE

A yellow crystalline explosive compound melting at 78-80°C. It is less powerful than either Trinitroanisole or TNT and has a rate of detonation of 6900 meters/sec. It is used cast loaded as a main burster charge in Projectiles. It can also be used alone as a Booster, and in mixtures with Picric Acid & Ammonium Nitrate as a main burster charge for Shells.

Keyaki — GELATIN DYNAMITE

Kibakuyaki (Initiating Explosive)

See Bakufun & Raibun (enka).

Kibakuzai (Primer Charge)

See Chikkaen (Navy) or Ckikka Namari (Army) & Raikō or Raisan Suigin.

Kiri Nos 1, 2 & 3 — GELATIN DYNAMITE

Ko (Explosive) or Type 88 (Ko) — JAPANESE TYPE EXPLOSIVES

See Type 88 (Ko).

Kokoshokuyaku or Yuenyaku — BLACK POWDER

Used by the Army as a main charge in 20-mm Machine Gun Ammunition; as an ejector charge for 70-mm Mortar Shells, pyrotechnics & Shrapnel Shells; as Delays, Relays & Igniters in Bombs, Projectile Fuzes and pyrotechnics; and as a "substitute charge" for some Bombs & Projectiles.

Used by the Navy for the same purposes as the Army.

Koshitsu, Oshitsuyaku or Shouyaku Koshitsu — KOSHITSU COMPOSITION C

A brown, putty-like plastic explosive composition consisting of RDX 80 to 85% & oil 20 to 15%. Its brisance by sand test is 46.5 gm sand crushed vs 43 gm for TNT; relative power by ballistic mortar 125% TNT; rate of detonation 7400 meters/sec. vs 6900 for TNT; and impact & friction sensitivity are of the same order as TNT. This composition retains its plasticity between $0^{o}C$ ($32^{o}F$) and $37.8^{o}C$ ($100^{o}F$). Below $0^{o}C$ it becomes brittle, and above $37.8^{o}C$ it becomes gummy and slowly exudes oil. It is used in Demolition Cartridges 4" long and 1 1/2" in diameter, and in Shaped Demolition Charges is reported to be 21% more effective than TNT shaped charges.

Ko-Shoan Bakuyaku — AMMONIUM NITRATE DYNAMITE

L-Shoan — AMMONIUM NITRATE DYNAMITE

Matsu — BLASTING GELATIN

Meiayaku or Sanshōki Mechiru Nitoroamin — TETRYL

Used as a standard Sub-Booster in Army & Navy artillery shells and occasionally as the sole Booster in Navy 25-mm Shells, and as burster in some Shells.

It is also used in a composite explosive called Tanōyaku.

Menkayaku — NITROCELLULOSE

Menyaku — GUNCOTTON

Muenkayaku or Muenyaku — SMOKELESS POWDER

Nigotanoyaku, Mk_2 — COMPOSITION B

Pale yellow mixtures of RDX & TNT (60/40, 47/53, 40/60 & 30/70), also called Cyclotols in the US, are used cast loaded in Bombs, Projectiles, Land Mines, Bangalore Torpedoes and in Demolition Blocks (47/53 RDX/TNT). The 50/50 RDX/TNT mixture is called Chauyaku (qv).

Nitoroguriserin — NITROGLYCERIN

Used in some Dynamites such as Sakura Nos 1 & 2 (trade names of the Nippon Oils and Fats Co., Ltd.) and in double-base Propellants.

Ōnayaku — ŌNAYAKU

Yellow, castable explosive compositions consisting of Picric Acid 50 to 80% & dinitronaphthalene 50 to 20%. It melts below 120°C; its power, brisance & rate of detonation are lower than similar values for Picric Acid alone. It is also less sensitive to impact & friction than Picric Acid. This mixture is used as a main bursting charge in Artillery Projectiles. The 80/20 mixture is similar to the Soviet mixture Frantsuzs_kaya_smes' and the 50/50 mixture is similar to the Soviet mixture Ruskii_splav (see under Soviet Explosives).

Oshitsuyaku — KOSHITSU

See Koshitsu.

Ōshiyaku — ŌSHIYAKU

A yellow, press-loaded explosive composition consisting of Picric Acid 90% & wax 10%. Its power, brisance & rate of detonation are lower than similar values for Picric Acid alone. It is much less sensitive to impact & friction than Picric Acid. It is used as a main filler for some Armor-Piercing Projectiles.

Ōshokuyaku (Army), Shimose, Shimose Bakuyaku (Navy) or Pikurinsan — PICRIC ACID

Used by the Army as a main press-loaded booster charge in Bombs, Projectiles & Mines, and in standard Demolition Blocks. Used cast loaded in Bombs, Projectiles, Land Mines & Bangalore Torpedoes. It is also used in several explosive compositions such as Chaōyaku (qv), Onayaku (qv) & Oshiyaku (qv).

Otsu-B, Type A (Explosive) or A(ko) — A(KO)

See A (ko).

Pentoriru — PENTOLITE

The 50/50 PETN/TNT mixture is used cast loaded in Navy 20-mm & 30-mm Projectiles and in some Shaped Charges.

Pikurinsan — PICRIC ACID

See Ōshokuyaku.

Pikurinsan Ammonia — AMMONIUM PICRATE

Used in composite explosives Type I; Type I Mk5, P5; Type I Mk6; and others.

Raibun (enka) — RAIBUN(ENKA)

A light gray to tan mixture consisting of Potassium Chlorate 60% & antimony sulfide 40%. This mixture is called "thunder powder" or "smoke & fire". It is used as a primer in pyrotechnics and as a fuze primer. See also Bakufun.

Raikō or Raisan Suigin — MERCURY FULMINATE

Used in instantaneous Fuzes & in Blasting Caps. In some instantaneous Gaines, the striker fires the initiator directly. This compound, known as "thunder mercury", is also used in a mixture called Bakufun (qv).

Sakuma Dainamaito — DYNAMITE

Sakura Nos. 1 & 2 — BLASTING GELATIN

Sanshōki Mechiru Nitoroamin or Meiayaku — TETRYL

See Meiayaku.

Sanshōki Toruōru, Type 92 (Navy) or Chakatsuyaku — TNT

See Chakatsuyaku.

Seigata (Army) or Type 97H (Navy) — SEIGATA

A light yellow to orange castable explosive charge consisting of TNT 60% & Hexanitrodiphenylamine 40%. Its cast density is 1.65 gm/cc; explosion temperature 302° to 480°C; relative brisance by copper cylinder crusher method 96% (Picric Acid = 100%); relative power by ballistic mortar 92%; rate of detonation 7100 meters/sec; impact sensitivity 14 cm (maximum cm for no explosions with a 5 kg weight); and friction sensitivity 60 kg (maximum pressure between two rubbing surfaces for no explosions).

It was used at the beginning of WW II in some Torpedo Warheads (precast into blocks and then loaded), but was later replaced by A(ko) or Type A (Explosive). It was also used in Depth Charges & in Navy Rocket Warheads.

Shakunetsuzai — THERMITE

Used in admixture with Black Powder or high explosive as a main filler for Army Chemical Bombs. It is also used as the filler for some Hand Grenades called Shakunetsu Tekidan.

Shimose — PICRIC ACID

See Ōshokuyaku.

Shimose Bakuyaku (Navy) or Ōshokuyaku (Army) — PICRIC ACID

See Ōshokuyaku.

Shin-Kiri — GELATIN DYNAMITE

Shinkyoryoku — GELATIN DYNAMITE

Shin-Toku-Shoan — AMMONIUM NITRATE DYNAMITE

Shiraume — GELATIN DYNAMITE

Shoan Bakuyaku — AMMONIUM NITRATE DYNAMITE

An explosive composition consisting of Ammonium Nitrate 79%, dinitronaphthalene 10%, sodium chloride (salt) 10% & sawdust 1%. This composition is used in Demolition Charges.

Shoan Bakuyaku Nos. 104 & 201 — AMMONIUM NITRATE DYNAMITE

Shoanyaku — AMMONIUM NITRATE DYNAMITE

A series of coal-mining explosives manufactured at the Uji Factory, Kyoto Prefecture, Japan. Some specific compositions are as follows:

a) No I: Ammonium Nitrate 70%, dinitronaphthalene 9%, sodium chloride (salt) 20% & woodmeal 1%.

b) No 2: Shoan Bakuyaku (composition is given above).

c) No 5: Ammonium Nitrate 64%, TNT 12%, sodium chloride (salt) 20%, woodmeal 3% & wheat starch 1%.

d) No 6: Ammonium Nitrate 71%, TNT 12%, sodium chloride 13%, woodmeal 3% & wheat starch 1%.

e) No 7: Ammonium Nitrate 75%, dinitronaphthalene 9%, TNT 1.5%, sodium chloride (salt) 13% & woodmeal 1.5%.

f) Special: Ammonium Nitrate 64%, dinitronaphthalene 3%, TNT 7%, sodium chloride (salt) 20%, woodmeal 2%, Guanidine Nitrate 2% & sodium nitrate 2%.

These explosives have impact test values of about 80 cm with a 2-kg weight, and gap test values of 100 to 150 mm. Some of the mixtures are used as military Demolition Charges.

Shōbenyaku or Anbenyaku — ANBENYAKU

See Anbenyaku.

Shoeiyaku — PETN

White crystalline compound melting at 140°C. It is compressed to a density of 1.60 gm/cc; relative brisance as determined by copper cylinder crusher method 128% (Picric Acid = 100%); relative power by ballistic mortar 108% (Picric Acid = 100%); explosion temperature 205°C; rate of detonation by Dautriche method 8400 meters/sec; impact sensitivity 13 cm (maximum cm for no explosions with a 5-kg weight); and friction sensitivity 60 kg (maximum pressure in kg for no explosions between two rubbing surfaces).

It is used press loaded in Army 7.7-mm & Navy 12.7-mm Fuzeless Projectiles, and in 20-mm Machine Gun Projectiles. It is also used as a Booster and in upper & lower detonators in small Shells. In addition to being used alone, it is used in some composite explosives such as Pentoriru (qv) and in "unknown name explosives": PETN & wax, as burster charge in 13-cm & 15-mm Incendiary Shells; PETN 91.5% & wax 8.5%, as burster charge in 20-mm Self-Destroying Shells; PETN 58% & RDX 42%, as burster charge in 7.7-mm & 12.7-mm Projectiles; and PETN 17% & RDX 83%, in Army 7.7 mm Projectiles.

It is also used in composite explosives called Angayaku & Pentoriu, and in some Unknown Name Explosives (qv):

Shonayaku (Shon-ō-yaku) — SHONAYAKU

A yellow-brown explosive consisting of Ammonium Nitrate 90% & dinitronaphthalene 10%. It is used as a main charge in Army semi-steel Shells, in Land Mines, and as a Demolition Charge.

Shōtoyaku — AMATOL

A 50/50 Ammonium Nitrate/TNT mixture is used as a castable main charge in some Bombs & Projectiles, especially in semi-steel shells. It is reported to be found in some Navy Mines. Because of a shortage of TNT, very little Amatol is used in military explosives.

Shouyaku or Tanayaku — RDX

White crystalline compound compressed to a density of 1.60 gm/cc. It melts at 200°C; explosion temperature 240°C; has relative brisance as determined by copper cylinder crusher method 115% (Picric Acid = 100%); rate of detonation by Dautriche method

Shouyaku (cont'd)

8380 meters/sec; and impact sensitivity 13 cm (maximum cm for no explosions with a 5-kg weight).

Straight RDX is used as a burster charge in 20-mm & 37-mm Shells, in Caliber .50 & 7.7-mm Bullets, and in some Land Mines. It is also used as a Booster and as Sub-Booster in Bomb Fuzes.

In addition to being used alone, RDX is used in the following composite explosives: Angayaku, Chauyaku, Haishokuyaku, Koshitsu, Nigotanoyaku Mk 2, Shoeiyaku Composite Explosives, Tanōyaku, Type 94M Explosive, and in several Unknown Name Explosives (qv) as main filler for various kinds of projectiles.

Shouyaku Koshitsu — KOSHITSU

See Koshitsu.

Take Nos. 1, 2 & 3 — GELATIN DYNAMITE

Tanayaku or Shouyaku — RDX

See Shouyaku.

Tanōyaku — TANŌYAKU

Two composite mixtures are reported:

Tanōyaku No 1: RDX 60%, TNT 30% & Tetryl 10%.

Tanōyaku No 2: RDX 55%, TNT 38% & Tetryl 7%.

No properties of these mixtures are given. They are used as cast-loaded carton charges for various projectiles.

Toku-Shiraume Nos. 1 & 2 — GELATIN DYNAMITE

"Type" Explosives: — JAPANESE "TYPE" EXPLOSIVES

A series of explosives used by the Japanese Navy. See below.

Type A (Explosive), Otsu-B or A(ko) — A(KO)

See A(ko).

Type K (Explosive) JAPANESE "TYPE" EXPLOSIVES

A series of explosives based on mixtures of inorganic salts & fuels were developed during WW II. They are probably similar to German "Substitute Explosives" (Ersatzsprengstoffe). Their compositions & uses are not known.

Type 1 (Explosive) JAPANESE "TYPE" EXPLOSIVES

A dark-gray, press-loaded explosive consisting of Ammonium Picrate 81%, aluminum 16%, sawdust 2% & crude petroleum 1%. It is about equal to TNT in sensitivity, 36% greater in strength than TNT, but less brisant than TNT as measured by the sand test. The rate of detonation is 4300 meters/sec. This explosive is used very effectively as a main charge for Depth Bombs or other underwater ordnance.

Type 1 Mk5, P5 JAPANESE "TYPE" EXPLOSIVES

A dark-green explosive composition consisting of Ammonium Picrate 81%, ferrosilicon 16%, woodpulp 2% & heavy oil 1%. This mixture has an apparent density 1.16 gm/cc; relative brisance as determined by copper cylinder crusher method 99% (Picric Acid = 100%); relative power by ballistic mortar 72% (Picric Acid = 100%); explosion temperature 450°C; rate of detonation 4100 meters/sec; impact sensitivity 15 cm (maximum cm for no explosions with 5 kg weight); and friction sensitivity 60 kg (maximum pressure in kg between two rubbing surfaces for no explosions).

This mixture is used press loaded in some Depth Charges.

Type 1 Mk6, P6 JAPANESE "TYPE" EXPLOSIVES

A dark-green explosive composition consisting of Ammonium Picrate 86%, ferrosilicon 11%, woodpulp 2% & heavy oil 1%. This mixture has an apparent density 1.13 gm/cc; relative brisance as determined by copper cylinder crusher method 95% (Picric Acid = 100%); explosion temperature 450°C; rate of detonation by Dautriche method 4620 meters/sec; impact sensitivity 13 cm; and friction sensitivity 60 kg.

This mixture is used press loaded in Depth Charges.

Type 2 (Explosive) or
B 4 (Incendiary)

B 4(INCENDIARY)

See B 4 (Incendiary).

Type 4 (Navy)

JAPANESE "TYPE" EXPLOSIVES

A gray, non-toxic explosive composition consisting of Ammonium Perchlorate 79.2%, ferrosilicon 16.4%, aluminum & iron powder 1.0%, heavy oil 2.5% & unaccounted 0.9%. This mixture has properties similar to Type 88 Explosive (qv) but does not burn as easily. It is used in Depth Charges.

Type 4 Mk 1, K1

JAPANESE "TYPE" EXPLOSIVES

A grayish-white, non-toxic explosive composition consisting of Ammonium Perchlorate 80%, talc 10%, ferrosilicon 8% & chloronaphthalene 2%. This mixture has an apparent density 1.24 gm/cc; brisance as measure by copper cylinder crusher method 89% (Picric Acid = 100%); relative power by ballistic mortar 84% (Picric Acid = 100%); rate of detonation by Dautriche method 3600 meters/sec; explosion temperature 455°C; impact sensitivity 18 cm (maximum cm for no explosions with a 5-kg weight); and friction sensitivity 60 kg (maximum pressure in kg between two rubbing surfaces for no explosions).

This mixture is used press loaded in Sea Mines & Depth Charges.

Type 4 Mk 2, K2

JAPANESE "TYPE" EXPLOSIVES

A grayish-black, non-toxic explosive composition consisting of Ammonium Nitrate 89%, woodpulp 5% & coal tar 6%. This mixture has an apparent density 1.00 gm/cc; brisance as measured by copper cylinder crusher method 70% (Picric Acid = 100%); relative power by ballistic mortar 82% (Picric Acid = 100%); rate of detonation by Dautriche method 3900 meters/sec; explosion temperature 470°C; impact sensitivity 34 cm; and friction sensitivity 60 kg.

This mixture is used press loaded in Sea Mines & Depth Charges.

Type 4 Mk 3, K3

JAPANESE "TYPE" EXPLOSIVES

A grayish-white, non-toxic explosive composition consisting of Ammonium Perchlorate 47%, ammonium sulfate 32%, ferrosilicon 20% & chloronaphthalene 1%. This mixture has an apparent density 1.20 gm/cc; relative brisance 83% (Picric Acid = 100%); relative power 81% (Picric

Type 4 Mk 3, K3 (cont'd)

Acid = 100%); rate of detonation 2900 meters/sec; explosion temperature 470°C; impact sensitivity 20 cm; and friction sensitivity 60 kg.

It is used press loaded in Sea Mines & Depth Charges.

Type 4 Mk 4, K4 — JAPANESE "TYPE" EXPLOSIVES

A white, non-toxic explosive composition consisting of Sodium Chlorate or Potassium Chlorate 88% & petroleum 12%. This mixture has an apparent density 1.05 gm/cc; relative brisance 77%; relative power 59%; explosion temperature 580°C; impact sensitivity 14 cm; and friction sensitivity 60 kg.

It is used press loaded in Sea Mines & Depth Charges.

Type 4 Mk 5, K5 — JAPANESE "TYPE" EXPLOSIVES

A gray, non-toxic explosive composition consisting of Ammonium Perchlorate 55%, Ammonium Nitrate 29%, ferrosilicon 10%, woodpulp 5% & heavy oil 1%. This mixture has an apparent density 1.05 gm/cc; relative brisance 92%; relative power 81%; explosion temperature 450°C; impact sensitivity 28 cm; and friction sensitivity 60 kg.

It is used press loaded in Sea Mines & Depth Charges.

Type 4 Mk 6, K6 — JAPANESE "TYPE" EXPLOSIVES

A yellow-brown, non-toxic explosive composition consisting of Sodium Chlorate 84%, woodpulp 6% & petroleum 10%. This mixture has an apparent density 1.35 gm/cc; relative brisance 78%; relative power 67%, impact sensitivity 17 cm; and friction sensitivity 60 kg.

It is used press loaded in Sea Mines & Depth Charges.

Type 4 Mk 7, K7 — JAPANESE "TYPE" EXPLOSIVES

A grayish-black, non-toxic explosive composition consisting of Sodium Chlorate 84%, woodpulp 5%, wood charcoal 8% & coal tar 3%. This mixture has an apparent density 1.2 gm/cc; relative brisance as determined by copper cylinder crusher method 82%; relative power by ballistic mortar 63%; explosion temperature 385°C; impact sensitivity 25 cm (maximum cm for no explosions with a 5 kg weight); and friction sensitivity 30 kg (maximum pressure in kg between two rubbing surfaces for no explosions).

Type 4 Mk 7, K7 (cont'd)

This mixture is used in Sea Mines & Depth Charges.

Type 88 (Navy) or Karitto (Army) — JAPANESE "TYPE" EXPLOSIVES

A gray, non-toxic explosive composition consisting of Ammonium Perchlorate 66%, silicon carbide 16%, woodpulp 12% & petroleum 6%. This mixture has properties similar to those of the Type 4 Explosives. It is nonhygroscopic, stable in storage and safe to handle but very sensitive to friction. On burning, very poisonous fumes are produced.

The Navy uses this explosive loosely packed in Mines & Depth Charges. The Army uses it in the same manner as a substitute Demolition Charge. It is reported to be used extensively for industrial purposes, and is being utilized in experimental solid Rocket Propellants. Since the development of this composition, several modifications have appeared. See other Type 88 Explosives below.

Type 88 (Ko) or Haensosan Bakuyaku — JAPANESE "TYPE" EXPLOSIVES

A gray, non-toxic explosive composition consisting of Ammonium Perchlorate 75%, ferrosilicon 16%, woodpulp 6% & crude petroleum 3%. It has an apparent density 1.05 gm/cc; more powerful but less brisant than TNT; rate of detonation 4000 meters/sec; explosion temperature 430°C; impact sensitivity 17 cm (maximum cm for no explosions with a 5-kg weight); and friction sensitivity 30 to 40 kg (maximum pressure in Kg between two rubbing surfaces for no explosions).

This mixture is used by the Navy press loaded into Sea Mines. It is considered to be too sensitive for use as a main filler in Shells.

Type 91 (Navy) — JAPANESE "TYPE" EXPLOSIVES

A yellow powder melting at 64 to 68°C and having an explosion temperature of 279°C. Its cast density is 1.60 gm/cc; brisance by copper cylinder crusher method 92% (Picric Acid = 100%); relative power by ballistic mortar 101% (Picric Acid = 100%); rate of detonation 6600 meters/sec; impact sensitivity 19 cm; and friction sensitivity 60 kg.

This explosive is used straight for cast loading Armor-Piercing Projectiles. It is also used in composite explosives such as A (ko), Type A (Explosive) or Otsu-B; B 4 (Incendiary or Type 2 (Explosive); "E" (Explosive); H_2 Kongo or Type 98 (Explosive); Type 94M (Navy); and others.

Type 92 (Navy) TNT

A term applied by the Navy to straight TNT.

This name is also applied to a composite mixture consisting of TNT 66% & aluminum powder 34% which is cast loaded into Navy 25-mm Projectiles. This explosive may be considered as a modified German Tritonal. See Chakatsuyaku.

Type 94M (Navy) JAPANESE "TYPE" EXPLOSIVES

A cream-yellow explosive composition consisting of Trinitroanisole 60% & RDX 40%. It has a cast density of 1.64 gm/cc; relative brisance as determined by copper cylinder crusher method 107% (Picric Acid = 100%); relative power by ballistic mortar 112% (Picric Acid = 100%); rate of detonation by Dautriche method 7700 meters/sec; explosion temperature 216°C; impact sensitivity 13 cm (maximum cm for no explosions with a 5 kg weight); and friction sensitivity 40 to 50 kg (maximum pressure in kg between two rubbing surfaces for no explosions).

This is considered to be one of the most powerful underwater explosives, but it is toxic, unstable and sensitive to sympathetic detonation. It is reported to attack some metals.

It is used in shaped-charge Grenades and as a Booster surround. Its former use in Torpedo Warheads was discontinued due to its sensitivity to sympathetic detonation.

Type 97H (Navy) SEIGATA

See Seigata.

Type 98 (Army & Navy) H_2KONGO

See H_2 Kongo.

Unknown Name Explosives: JAPANESE UNKNOWN NAME EXPLOSIVES

(Designations are given only for convenience)

X-1

A mixture of potassium chlorate & antimony sulfide. No proportions or properties are reported. It is used in Primer Caps & Fuze Primers.

X-2

A pressed mixture of PETN 58% & RDX 42%. It is used as a main filler for Army 7.92 mm & 12.7 mm Projectiles.

X-3

A pressed mixture of RDX 83% & PETN 17%. It is used as a main filler in 7.7-mm Projectiles.

X-4

A pressed mixture of RDX 92-95% & wax 8-5%. It is used as a main charge in 20-mm Antiaircraft Shells. See Shouyaku.

X-5

A pressed mixture of RDX 85% & wax 15%. It is used as a main filler in 75 mm Armor-Piercing Projectiles and also other ammunition.

X-6

A pressed mixture of RDX & aluminum powder. Aluminum is reported to be added for its incendiary effect. The specific use of this explosive is not known.

X-7

A pressed mixture of PETN & wax. It is less powerful, less brisant & less sensitive than straight PETN. It is reported to be used as a main burster charge in Incendiary Shells, and as a booster in 13-mm & 15-mm Projectiles.

X-8

A brown explosive composition consisting of Ammonium Chlorate 51.5%, barium nitrate 34.5%, Trinitronaphthalene + oil 8.2%

woodpulp 5.0% & other ingredients 0.8%. This mixture burns with a green color and is reported to be dangerous to burn in quantity. It is used as a booster in some Demolition Charges.

Yuenyaku or
Kokoshokuyaku

BLACK POWDER

See Kokoshokuyaku.

Unusual Research & Development in the Field of Explosives

"Thermal Decomposition of Some Explosive Compounds"

An apparatus for measuring the ignition temperature of explosive samples is described. Pressure curves recording the ignition process are also given. The effects of vessel volume, mixed substances, metal surfaces, and an atmosphere of air and other gases on the thermal decomposition process were studied. The limiting quantity of charge necessary for ignition at various temperatures and under reduced pressure was determined for 15 of the more common explosives.

[Ref: T. Hikita, Japan Science Review, Engineering Sciences 1, No 2, 23-28 (1950) & Chemical Abstracts 45, 2669 (1951)].

"Progress in the Theory of Detonation"

A review, including the theories of mechanism, the equation of state, the internal energy, and the composition of detonation products. Twenty-one references are cited.

[Ref: T. Hikita, Journal of the Industrial Explosives Society Japan 13, 3-8 & 77-85 (1952) & Chemical Abstracts 49 2736 (1955)].

"Molecular Theory of Detonation"

The equation of state of gas at high temperature is derived as

$$k\,T/(pv) = (1 - \alpha x)\,(1 + ax + bx^2 + cx^3)$$

where p, v, k and T are of conventional meaning and $x = (\lambda\ /pv)^{3/n}/v$. The intermolecular potential of the form

$$U = \lambda\ r^{-n}\ (\lambda > 0,\ n > 3)$$

is assumed. The constants a, b, c and α are given for n = 9 and for n = 12. This equation is applied to the detonation of PETN, TNT & Tetryl; and the case of n = 9 fits the experimental results.

[Ref: T. Kihara & T. Hikita, Journal Industrial Explosives Society Japan 13, 106-13 (1952) & Chemical Abstracts 49, 5841 (1955)].

"Study of the Muzzle Flashes of Explosives by Means of High-Speed Cinematographic Camera"

The muzzle flashes of TNT, Black Powder, Gelatin Dynamites & Ammonium Nitrate Dynamites expelled from the muzzle of a mortar were photographed by a 16-mm camera at the rate of 4500-5000 frames per second. The jetting velocities of exploded gases of the above explosives are between 1300-2300 meters/second and decrease rapidly (within 1 millisecond) to 300-500 meters/second. These velocities are almost in parallel relation to the detonation velocities of the corresponding samples. The maximum propagation velocity of the second flame of TNT is 560 meters/sec.

[Ref: T. Okawa, Journal Industrial Explosives Society Japan 13, 247-54 (1952) & Chemical Abstracts 49 5841 (1955)].

"A Method of Measuring Detonation Velocity of Short Charges"

A simple and convenient method is described that uses an electron-ray tube with connected condensers which form 2 arms of a bridge; the other 2 arms are a twin triode. When 2 lead wires are cut by a detonation at a certain time interval, the grid potentials are applied to suppress the plate current, the difference in time resulting in an oscillogram superposed with 463 kc or 1023 kc.

[Ref: T. Hikita & K. Yoneda, Journal Industrial Explosives Society Japan 14, 30-33 (1953) & Chemical Abstracts 49, 5841 (1955)].

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A.B. Schilling, "Grenade, Serrated, Cast Iron (Hand Use or with Japanese Type 10 Grenade Discharger), FMAM-336", Picatinny Arsenal Fragmentation Report 150 (September 1943).

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A.B. Schilling, "Examination of 50-mm Japanese Non-Serrated Grenade for Japanese Type 89 Grenade Discharger (FMAM-226)", Picatinny Arsenal Technical Report 1544 (July 1945).

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Soviet Explosives

A good description of the Soviet explosives used during WW II is given by A. E. Pereverzev, [Trudy Leningradskago Tekhnologicheskago Instituta im Leningrad Soveta 1946, No. 12, 46-68 & Chemical Abstracts 44, 6626-27 (1950)], who reports that no essentially new high explosives were used as bursting charges in shells or other ammunition. Most improvements came from compounding previously known explosives in various mixtures, and in improved techniques for loading such charges.

The principal aromatic explosives used are TNT, Picric Acid, Hexanitrodiphenylamine, Dinitrophenol, Tetryl, Dinitronaphthalene & Trinitro-m-xylene (alone or in mixtures with Ammonium Nitrate and/or other substances). The principal aliphatic explosives used are PETN, RDX & Nitroguanidine. Since PETN & RDX are too sensitive to be used alone as a bursting charge, they are phlegmatized (desensitized) with wax, TNT or other coating to render them less sensitive to mechanical shock. Aluminum powder is also added to some explosive mixtures or nitrocompounds to give added explosive force in the bursting charge.

Some captured Soviet ammunition, examined at Picatinny Arsenal, revealed a two-layer, separate loaded type of bursting charge, novel from the American point of view. For example, the 76.2-mm Armor-Piercing HE Shell contained a less sensitive Nose Charge of "Baronal" (barium nitrate 39%, TNT 15% & aluminum 46%); and a more sensitive Base Charge of "PTX-1" (RDX 72%, TNT 16% & Tetryl 12%). The effectiveness of these combined charges is not reported.

The principal explosives known & used in the USSR, as learned from various sources, are listed alphabetically in the following pages.

A, AT or Amatol | AMATOL

See Amatol.

A-IX-2 | A-IX-2

An explosive mixture consisting of RDX 73%, aluminum powder 23% & wax 4%. It is used as a bursting charge in some Projectiles.

Almatrit | ALMATRIT

Almatrits are commercial explosives developed in the USSR in 1925. They contain chlorates or perchlorates, together with combustible organic materials. They are claimed to be as stable but less sensitive than Cheddites. The following are compositions and some properties of Almatrites:

a) Kaliialmatrit No. 55

Potassium Chlorate		88%
paraffin	30%	12%
rosin	65%	
petrolatum	5%	
Density		1.15 gm/cc
Brisance (by compression of		10.2 mm
lead cylinder) vs TNT value		18.0 mm

b) Natriialmatrit No. 19

Sodium Chlorate		90%
paraffin	92.5%	10%
rosin	2.5%	
petrolatum	5.0%	
Density		1.40 gm/cc
Brisance (by compression of		14.0 mm
lead cylinder) vs TNT value		18.0 mm

c) Ammonalmatrit No. 98

Ammonium Chlorate		89%
paraffin	27%	11%
rosin	65%	
petrolatum	8%	
Density		1.17 gm/cc
Brisance (by compression of		16.2 mm
lead cylinder) vs TNT value		18.0 mm

Alumit No. 1 — ALUMIT NO. 1

A current commercial explosive consisting of Ammonium Nitrate 80%, TNT 12% & aluminum 8%. Its properties are: density 0.95-1.05 gm/cc, Trauzl test 400 cc vs 285 cc for TNT, and brisance by lead block compression test 16 mm vs 16-17 mm for TNT at density 1.59 gm/cc. It is reported to have been used during WW II as a bursting charge for medium-caliber Shells.

See also Ammonal.

Amatol — AMATOL

50/50 Amatol is used in some ammunition but to a lesser extent than 80/20 Amatol.

80/20 Amatol is used in many types of ammunition, such as 76.2- & 107-mm HE Shells; 82, 107 & 120-mm Mortar Shells; and 122-mm HE Howitzer Shells.

Ammiachnaya selitra — AMMONIUM NITRATE

See Ammoniinaya selitra.

Ammoksil or Ammonxyl — AMMOKSIL ; AMMONIUM NITRATE DYNAMITE

Ammoksils are commercial mining explosives consisting of: Ammonium Nitrate 82% and Trinitroxylene (called "ksilil" or "xylyl" in Russian) 18%, and Ammonium Nitrate 82%, Trinitroxylene 12% & aluminum powder 6%. Properties of the latter composition are: rate of detonation 5300 meters/sec; temperature developed on explosion 3380°C; heat of explosion 1180 cal/gm; and volume of gas evolved on explosion 836 liters/kg at STP.

Compare with Ammonit.

Ammonal — AMMONAL

Ammonals used for commercial and military purposes include: a) Ammonium Nitrate 82%, TNT 12% & aluminum 6%; b) Ammonium Nitrate 80% & aluminum 20% (coarse grained powder). This latter mixture has the following properties: Trauzl test value 520 cc; brisance (by Hess Lead Crusher Test) 15.5 mm at density 1.0 gm/cc and 22 mm at density 1.3 gm/cc vs 13.0 mm for loose uncompressed TNT; total volume of gas

Ammonal (cont'd)

evolved on detonation 700 liters/kg at NTP; heat of explosion 1680 cal/gm (with Al_2O_3 as solid) and 1270 cal/gm (with Al_2O_3 as gas).

See also Alumit No. 1.

Ammonalmatrit No. 98 — ALMATRIT

See Almatrit.

Ammoniinaya (Ammoniynaya) selitra — AMMONIUM NITRATE

Used in a number of composite explosives such as Amatol, Ammoksil or Ammonxyl, Ammonal, Ammonit, Ammonit-Goudronit; Ammonit, Predokhranitel'nyi; Ammonpek, Ammontol; Belit, Dinaftalit, Zernenyi; Dinamit, Dinamon, Gromoboy, Mansit, Shneiderit, Skal'nyi ammonit, and others.

According to investigations conducted in the USSR, the use of straight Ammonium Nitrate is not justified, but some investigators claim it is advantageous to use the straight compound in open mining operations.

Ammonit — AMMONIT, AMMONIUM NITRATE DYNAMITE

Ammonits are very much in use today. One report states that these explosives are the main types used in the USSR for industrial purposes. Some typical compositions are as follows:

a) Ammonit No. 2: Ammonium Nitrate 88% & TNT 12%.
b) Ammonium Nitrate 73%, potassium nitrate 15% & TNT 12%.
c) Ammonium Nitrate 77.6%, TNT 18.4% & woodmeal 4%.
d) Ammonium Nitrate 54.5 to 57.5%, TNT 8.5 to 9.5%, pine bark (finely ground) 2.5 to 3.5% & sodium chloride 31 to 33%.
e) Ammonium Nitrate 59.5 to 62.5%, Trinitroxylene 9.5 to 10.5% pine bark 2.5% to 3.5% & sodium chloride 25 to 27%.
f) Ammonit No. 6: A granular mixture of Ammonium Nitrate 79% & TNT 21%. Its density is 1.0-1.15 gm/cc; Trauzl test value 360 cc vs 285 cc for TNT; and brisance by lead block compression test 14 mm vs 16-17 mm for TNT.

The same composition pressed to a density of 1.25-1.35 gm/cc gives a Trauzl test value of 360 cc; brisance by lead block compression test 20 mm; and velocity of detonation 3800 meters/sec. Ammonit No. 6 is a commercial explosive used for blasting purposes.

Ammonit (cont'd)

g) Ammonit No. 7: Commercial blasting explosive consisting of Ammonium Nitrate 81%, TNT 14% & powdered pine bark 5%. Its density is 1.0-1.1 gm/cc; Trauzl test value 320 cc; lead block compression test 13 mm; and velocity of detonation 4070 meters/sec.

Ammonits safe for use in sulfur mines are prepared by combining Ammonit No. 8 (no composition is given in Chemical Abstracts) with flame attenuators, such as ammonium chloride, sodium chloride, aqeous agar-agar jelly or sodium sulfate dekahydrate. Sodium chloride proved to be ineffective for this purpose. [Ref: V.A. Assonov, Gornyi Zhur (Mining Journal, Russia) 126, No 7, 25-28 (1952) & Chemical Abstracts 47, 319-20 (1953)].

See also Ammonit-Goudronit; Ammonit, Predokhranitel'nyi and Skal'nyi ammonit.

Ammonit-Goudronit — AMMONIT GOUDRONIT; AMMONIUM NITRATE DYNAMITE

A coal mining explosive consisting of Ammonium Nitrate & tar (goudron). Its exact composition is not revealed, but its properties are reported as follows: oxygen balance to CO_2 4%; heat of combustion at constant volume 813 cal/gm; specific volume 963 liters/kg; temperature developed on explosion 2400 $^{\circ}K$; velocity of detonation 4000 meters/sec; Trauzl test value 320 cc; and brisance by lead cylinder compression test (Hess Method) 13 mm.

See also Ammonpek and under AMMONITE.

Ammonit, Predokhranitel'nyi (Safety Ammonite) — AMMONITE; AMMONIUM NITRATE DYNAMITE

This current commercial safety explosive consists of Ammonium Nitrate 68%, TNT 10%, powdered pine bark (or oil cake) 2% & sodium chloride 20%. It has a density of 1.0-1.5 gm/cc; Trauzl test value 240 cc (TNT = 285 cc); brisance by lead block compression test 11 mm (TNT = 16-17 mm); and velocity of detonation 2870 meters/sec (TNT = 6900 meters/sec at density 1.59 gm/cc).

Ammoniynaya (Ammoniinaya) selitra or Ammiachnaya selitra — AMMONIUM NITRATE

See Ammoniinaya selitra.

Ammonpek — AMMONPEK, AMMONIUM NITRATE DYNAMITE

Commercial coal mining explosive consisting of Ammonium Nitrate 95% and coal tar pitch (pek) 5%. This composition has the advantage of low sensitivity to initiation by shock. It has been used as a substitute for TNT. See also Ammonit-Goudronit.

Ammontol (formerly also called Russkaya smes') — AMMONTOL

A castable high-explosive mixture consisting of Ammonium Nitrate 50%, TNT 38% & Trinitroxylene 12%. It is used as a filler for Projectiles. See also Russkaya smes' for a different composition by this name.

Ammonxyl — AMMOKSIL

See Ammoksil.

Ammosol' — AMMOSOL', AMMONIUM NITRATE DYNAMITE

A permissible explosive, proposed in 1937 by C.I. Rudakovskii, consists of Ammonium Nitrate 56%, TNT 12% & sodium chloride 32%. Its oxygen balance is reported as +2.3%; heat of explosion 625 cal/gm; and temperature developed on explosion 2180°C. [Ref: M.K. Bandurin & L.G. Rukin, "Sbornik Zadach po Teórii Vzryvchatykh Veshchestv" (Collection of Problems Related to Theory of Explosives), Gos Izdat Oboron Prom, Moskva (1959), 113.]

AT or A — AMATOL

See Amatol.

Azido-tenerossovaya (of Lead Azide and Lead Styphnate) — AZIDO-TENEROSSOVAYA

A current detonator cap multilayer composition consisting of a 0.20- to 0.25-gm layer of Lead Azide covered with a 0.06- to 0.05-gm layer of Lead Styphnate. The bottom layer is usually Tetryl. This combination is loaded in a copper or German silver shell enclosed in an aluminum cup. It is used in various Caps and Detonating Fuzes for military ammunition.

See Kapsiuli detonatory.

Azid svintsa — LEAD AZIDE

It is used alone as the intermediate layer (0.13-0.21 gm) of all types of Russian multilayer Detonator Caps (Kapsiuli detonatory). The top layer consists of Lead Styphnate or Mercury Fulminate and the bottom layer of Tetryl, and occasionally RDX or PETN. A detonator top layer of Lead Azide 96% & Tetracene 4% (0.23 gm), and bottom layer of 0.48 gm PETN are used in the 30-mm Incendiary Shell.

Azid_svinsta (cont'd)

It is also used in the phlegmatized state (1-2% paraffin) in conjunction with Lead Styphnate placed in two distinct layers in many of the present Detonator Caps.

See Azido-tenersossovaya & Kapsiuli_detonatory.

Azotnokislyi_ammonii — AMMONIUM NITRATE

See Ammoniinaya selitra.

Belaya smes' (White composition) — BELAYA SMES'

A percussion-type explosive mixture consisting of Mercury Fulminate 80-85% & Potassium Perchlorate 20-15%.

Belit — AMMONIUM NITRATE DYNAMITE BELLITE

Bellites are commercial blasting & mining explosives. The original mixture contained Ammonium Nitrate & mononitrobenzene. The latter compound was replaced by Dinitrobenzene. Some current mixtures consist of: a) Ammonium Nitrate 35% & Dinitrobenzene 65%; b) Ammonium Nitrate 87% & Dinitrobenzene 13%; c) Ammonium Nitrate 80%, Dinitrobenzene 8% & Trinitroxylene 12%.

Bellites are used extensively in the USSR, primarily for coal mining.

Bezopasnoye_vzryvchatoye veshchestvo (Safety Explosive) — AMMONIUM NITRATE DYNAMITE

Buryi_porokh or Shokoladnyi_porokh — BROWN POWDER

Russian Brown Powder is similar in composition to Black Powder (Chornyi porokh), except that the charcoal used is brown (carbon content 70-75%) (Buryi porokh) or chocolate (carbon content 52-54%) (Shokoladnyi porokh). These powders are slower burning than Black Powder.

One source reports that some Soviet Delay Compositions (Sostavy zamedlennago deystviya), for time rings of Fuzes, consist of: a) potassium nitrate 59%, sulfur 37% & brown coal 4% - velocity of combustion 3 mm/sec; b) potassium nitrate 67%, sulfur 27% & brown coal 6% - velocity of combustion 3.8 mm/sec; c) potassium nitrate 76%, sulfur 17% & brown coal 7% - velocity of combustion 3.4 mm/sec.

Chörnyi porokh & Dymnyi porokh — BLACK POWDER

Two principal kinds of Black Powder were used during WW II: "melkozernistyi" (grains of 1 mm) &"krupnozernistyi" or "artilleriiskii" (grains of 5-10 mm). They were used in some Igniter & Delay Compositions, and as a bursting charge in some projectiles, such as Incendiary, Illuminating, Propaganda (agnitatsionnyi snariad) & Shrapnel Shells.

Following are the compositions of Soviet Black Powders:

Military - potassium nitrate 75%, sulfur 10% & charcoal 15%.

Fuse Powder - potassium nitrate 78%, sulfur 12% & charcoal 10%.

Blasting - a) potassium nitrate 75-84%, sulfur 8-10% & charcoal 8-15%. b) potassium nitrate 66.6%, sulfur 16.7% & carbon 16.7%.

Tubular - potassium nitrate 60-75%, sulfur 13-37% & charcoal 4-7%.

Sulfurless - potassium nitrate 80% & charcoal 20%.

Sporting - a) potassium nitrate 74-78%, sulfur 8-10% & charcoal 14-16%; b) potassium nitrate 80%, sulfur 8% & carbon 12%.

See also uses in Delay Compositions (Sostavy zamedlennago deystviya) and in Fuses (Ogneprovodnyi shnur).

Detoniruyoushchii shnur — DETONATING FUSE or PRIMACORD

The compositions of these cords are reported as follows:

Cord used in blasting operations a) Mercury Fulminate 75-80% & paraffin 25-20%; b) Mercury Fulminate 28%, Tetryl 71.5% & gelatin (binder and phlegmatizer) 0.5%. These cords have a detonation velocity of 5000 meters/sec at diameter of 5.5 mm. They are covered with 3 layers of fabric; c) Mercury Fulminate 73 $\pm$ 2%, Tetryl 27 $\pm$ 2% & gelatin 1.5 $\pm$ 0.5%. This composition is absorbed by 2 cotton threads. The fuse does not require a Blasting Cap. Ref: B.B. Rimkevich, Chemisches Zentralblatt (Berlin) 1942 II, 2760 & Chemical Abstracts 38, 2821 (1944) .

Detonating Fuse a) RDX having a velocity of 7600 meters/sec; b) a mixture of RDX & Tetryl having a velocity of detonation of 6500 meters/sec; c) grained PETN core enclosed in a cotton cloth tubing; d) also a mixture of PETN 90-97% & lead nitrate 10-3% to which 0.1-012% of red lead oxide (Pb_3O_4) is added.

Dinaftalit, Zernënyi (Granular Dinaphthalite) — SCHNEIDERITE

A granular explosive mixture consisting of Ammonium Nitrate 88% & dinitronaphthalene 12%. It is prepared by a special process which is not reported. It is used as a bursting charge in various Shells, and as a commercial blasting explosive. Its properties are: density 1.0-1.25 gm/cc, Trauzl test value 320 cc vs 285 cc for TNT, and brisance by lead cylinder compression test 15 mm vs 16-17 mm for TNT at density 1.59 gm/cc.

See also Shneiderit.

Dinamit — DYNAMITE

The principal types of Dynamites used in the USSR are as follows:

Gremuchii studen' (Blasting Gelatin) - Nitroglycerin 87-93% & Collodion Cotton 13-7%.

Plasticheskii dinamit (Plastic Dynamite) - Nitroglycerin 62-83%, Collodion Cotton 3-6%, potassium (or sodium) nitrate 27-29% & wood meal 8-2%.

Grisutin (Grisoutine) - Nitroglycerin (gelatinized by Collodion Cotton) 12-30% & Ammonium Nitrate (with absorbent such as limestone or sawdust) 88-70%. Some Grisoutine cartridges, 6" long & 1-1 1/2" in diameter, were thought to be used for military purposes. They were very sensitive to mechanical action and unstable when exposed to sun rays, heat or cold.

Dinamon — AMMONIUM NITRATE DYNAMITE DINAMON

Dinamons are blasting explosives based on mixtures of Ammonium Nitrate & combustible material:

a) Ammonium Nitrate (paraffined) 89% & peat (or pine bark dust) 11%. The composition is prepared by heating crystals of Ammonium Nitrate to 55-65 ^{o}C, stirring with 1.5-2.0% of paraffin, and adding the dry peat. After thououghly blending, the composition is pressed into cartridges. Ordinary paper is used for wrapping because this mixture does not absorb moisture. Its Trauzl test value is 330 cc, brisance by lead cylinder compression test 11 mm, and velocity of detonation 2500 meters/sec. Corresponding values for TNT are 285 cc, 16-17 mm and 6900 meters/sec at density 1.59 gm/cc.

Dinamon (cont'd)

b) Dinamon K: Ammonium Nitrate 90% & vegetable meal (such as sawdust, resin meal or pitch) 10%. Its Trauzl test value is 300 cc (vs 225 for straight Ammonium Nitrate). It is stable in storage and easily exploded even if the mixture contains 2.5% of moisture.

Dinamons are used for blasting hard ores on lower mine levels, for excavating, and for demolition work on wood or concrete. They are unsuitable for use on steel armor work.

Ekrasit — AMMONIUM TRINITROCRESYLATE

It is used as a bursting charge in some ammunition.

Elektrozapal — ELEKTROZAPAL

The so-called "Elektrozapal Inzhenernago Vedomstva" (Electric Primer of Corps of Engineers) is used almost exclusively for military purposes. It contains a platinum bridge wire surrounded by a small amount of unpulped Nitrocellulose which is in direct contact with the following mixture: Potassium Chlorate 40%, lead ferrocyanide 40% & graphite powder 20%. This mixture can be replaced by one consisting of Guncotton (gelatinized by ether/alcohol), lead ferrocyanide & Potassium Chlorate.

Flegmatizirovannyi gheksoghen — COMPOSITION A
(Phlegmatized or Desensitized RDX)

RDX is mixed with a small quantity of wax, paraffin or ceresin and pressed to a density of 1.65 gm/cc. This filler is used as a bursting charge for some Shells.

See also Gheksoghen.

Flegmatizirovannyi TEN — PETN
(Phlegmatized or Desensitized PETN)

A mixture of PETN with up to 5% wax or paraffin is used in Detonators, and as the bursting charge in Shaped-Charge Shell & other Projectiles.

See also Tetraeritrit nitrat (TEN).

Flegmatizirovannyi trotil | TNT
(Phlegmatized or Desensitized TNT)

A desensitized TNT mixture consisting of TNT 94%, naphthalene 4% & Dinitrobenzene 2%. It was used during WW II as a bursting charge for Armor-Piercing Shells (Broneboynykh snairiadov).

See also Trotil.

Frantsuzskaya smes' | FRANTSUZSKAYA SMES'

This so-called French Mixture consists of Picric Acid 80% & dinitronaphthalene 20%. It is used as a bursting charge for Shells, Aerial Bombs & Antitank Mines, and also Demolition Charges (podrivnyye shashki) of the same sizes as those filled with TNT. One source reports this mixture was used during WW II for loading Antitank Mines made of wood.

See also Ōnayaku under Japanese Explosives.

Ful'minat rtuti or Gremuchaya rtut' | MERCURY FULMINATE
See Gremuchaya rtut'.

Gheksoghen | RDX

Straight RDX is used in some Detonators, Detonating Fuses & Boosters. RDX phlegmatized with wax is used for filling some small-caliber Projectiles. A more extensive use of RDX is made in admixtures with other explosives. A mixture of RDX/TNT/Tetryl - 71.9/16.4/11.7% is used for filling 76.2-mm Armor-Piercing HE Shells. A mixture of RDX/TNT (50/50, 40/60 & 20/80%) is used in Shaped Charges. A mixture of RDX 75%, aluminum 21% & binder 4% is used as a bursting charge in 25-mm HE Shells, in 45-mm Armor-Piercing HE Tracer Shells, and in 85-mm Antiaircraft Shells. RDX is also used in admixtures with TNT as castable fillers for Shells and other items of ammunition.

See also A-IX-2, Azid svintsa, Detoniruyoushchii shnur, Flegmatizirovannyi gheksoghen, and Tetritol-Gheksoghen Brizantnoye VV, and Skal'nyi ammonit.

Gremuchaya rtut' or Ful'minat rtuti | MERCURY FULMINATE

It has been used extensively in Priming & Initiating compositions. It is still used in some Detonating Fuse & Cap Compositions. There is

Gremuchaya rtut' (cont'd)

the tendency to replace Mercury Fulminate by combinations of Lead Azide & Lead Styphnate.

See also Azido-tenerossovaya, Belaya smes', Detoniruyoushchii shnur, Kapsiuli detonatory, and Udarnyiye i initsiiruyushchiye sostavy.

Gremuchii studen' BLASTING GELATIN

Grisutin (Grisoutine Dynamite) DYNAMITE

Gromoboy GROMOBOY

A high-explosive mixture consisting of Ammonium Nitrate 72.5% & Ammonium Picrate 27.5%. Although proposed in 1886 by I.M. Tsel'tsov, this mixture undoubtedly was recently used for loading Shells & Mines.

See also Mansit.

Igdanit AMMONIUM NITRATE DYNAMITE IGDANIT

A blasting explosive consisting of a mixture of Ammonium Nitrate 95-97% & Diesel fuel oil 5-3%, combined just before use. It is reported that this explosive has better characteristics than Ammonit. [Ref: W.S. Khablov, Prom Stroit (Industrial Construction) 39, No 4,55-56 (1961); Chemical Abstracts 55, 20433 (1961); and Explosivstoffe 1964, 47].

Initsiiruyushchiye sostavy INITIATING COMPOSITIONS

See Udarnyiye i Initsiiruyushchiye.

K-1 splav (K-1 Fusion or K-1 Mixture) K-1 SPLAV

A castable high-explosive mixture consisting of TNT 70% & Dinitrobenzene 30%. It was used during WW II as a bursting charge for some Land Mines made of cast iron. Although this mixture is less brisant than TNT, it is too brisant for use in cast iron Projectiles as this material sometimes fragments into pieces too small to be effective. To reduce the brisance of this mixture, long blocks of a less brisant explosive such as Shneiderit were inserted into the charge. Although this modified filler gives satisfactory results, it is being replaced by the K-2 splav.

K-2 splav (K-2 Fusion or K-2 Mixture) K-2 SPLAV

A castable high-explosive composition consisting of TNT 80% & dinitronaphthalene 20%. It was used as a bursting charge in 82-mm Land Mines made from cast iron, and in small-caliber, shaped-charge projectiles. This mixture is less toxic than K-1 splav.

Kaliialmatrit No. 55 ALMATRIT

See Almatrit.

Kapsiuli detonatory — DETONATOR CAPS

Current Russian Detonator Caps are divided into four types:

Gremuche-rtutnaya (of Mercury Fulminate) - a charge of 0.2 gm Mercury Fulminate.

Azido-tenerossovaya (of Lead Azide and Lead Styphnate).

Kombinirovannaya-gremuchertutno-tetrilovaya (combined Mercury Fulminate and Tetryl) - a charge consists of 0.5-gm Mercury Fulminate as top layer, and up to 1.0-gm Tetryl as bottom layer. Sometimes Tetryl is replaced by PETN (-tenovaya) or RDX (-gheksoghenovaya).

Kombinirovannaya azido-tetrilovaya (combined Lead Azide and Tetryl) - the charge consists of 0.15-0.20 gm Lead Azide as top layer, and up to 1.0 gm Tetryl (PETN or RDX) as bottom layer.

See also Azido-tenerossovaya, Azid svintsa & Gremuchaya rtut'.

Khlopchatobumazhnyi porokh — GUNCOTTON

Kolloksilin — COLLODION COTTON

A Nitrocellulose of 11.5-12.0% Nitrogen content. It corresponds to US Collodion Cotton and is completely soluble in ether-alcohol & methanol. It is used in commercial & military dynamites.

Ksilil (or Xylyl) — TRINITROXYLENE

A Soviet term given to commercial Trinitroxylene which consists chiefly of the trinitroderivatives of meta-, ortho- & para-xylenes. It is a grayish-yellow substance obtained by the nitration of commercial xylene by means of mixed nitric-sulfuric acid. It is insoluble in water, slightly more sensitive to initiation than TNT, and about as sensitive to impact as TNT.

Ksilil is used as a partial substitute for TNT in composite explosives such as Ammoksil or Ammonxyl, Ammontol, Belit, L-splav, and others.

Such mixtures are used as bursting charges in Shells, Antitank Mines, and some Demolition Charges. A small amount of Ksilil, added to TNT, is claimed to make the explosive considerably more sensitive to initiation.

L-splav (L-Mixture) — L-SPLAV

An explosive mixture, invented by Ya. I. Leitman of the USSR, consisting of TNT 95% & Trinitroxylene (Ksilil) 5%. It melts at 74°C and has a cast density of 1.55 gm/cc. This mixture is not more sensitive to impact & rifle bullets than TNT, but is easier to initiate by other means. It requires a much smaller booster charge (Tetryl) for initiation than does TNT and with a strong detonator, no booster is required.

This explosive was used during WW II as a cast-loaded bursting charge for Antitank Mines, and in Demolition Blocks.

Mansit — MANSIT

A press-loaded explosive mixture consisting of Ammonium Nitrate 72%, Ammonium Picrate 23% & petroleum asphalt 5%. Its specific uses in ammunition are not reported.

See also Gromoboy.

Nakol'naya smes' (Needle-action or Pricking-action composition) — NAKOL'NAYA SMES

A non-corrosive, stab-action type composition consisting of Lead Styphnate 45%, Tetracene 5%, barium nitrate 30% & Antimony trisulfide 20%. It is used in various types of Igniter Caps initiated by a needle-type percussion striker.

See also Udarnyi sostav.

Natriialmatrit No. 19 — ALMATRIT

See Almatrit.

Nitroglitserin — NITROGLYCERIN

It is used primarily in the preparation of Dynamites such as Gremuchii studen', Grisutin & others, and in the preparation of Double-Base Propellants. Nitroglycerin is not suitable for use in composite explosives intended as bursting charges of Shells.

See also Pobedit.

Nitrokletchatka or Nitrotselulosa — NITROCELLULOSE

Ogneprovodnyi shnur (Flame Conducting Cord or Safety Fuse) — BLACK POWDER FUSE

A Safety Fuse made of compressed grains of Black Powder enclosed in a cloth tubing which is waterproofed.

Oktoghen — HMX

In addition to normal use as a component of powerful high-explosive mixtures, it is reported that HMX or other high-energy explosive and an explosive plasticizer instead of Nitroglycerin are incorporated in the casting solvent of Propellants and other Fuels for Rockets. A wide variety of formulations exhibiting better properties and performance characteristics are possible. Also HMX, RDX & PETN are being added to upgrade the performance of Double-Base Propellant systems.

Osvetitel'nyiye sostavy (Illuminating Compositions) — PYROTECHNICS

See under Pirotekhnicheskiye sostavy.

Pikrat ammoniya or Pikrinovokislyi ammonii — AMMONIUM PICRATE

It is used in some composite explosives, such as Gromoboy & Mansit probably intended as bursting charges for Bombs, Shells & other ordnance. Straight Ammonium Picrate is not used in Russia.

Pikrinovaya kislota, Trinitrofenol, or Melinit — PICRIC ACID

The manufacture of Picric Acid began in Russia about 1896 for the purpose of replacing pressed Gun Cotton, used at that time, as a bursting charge. The replacement was not yet completed when the manufacture of TNT was started in 1907. During WW I the Russians used three types of bursting charges: compressed Nitrocellulose, compressed Picric Acid, and TNT.

Pikrinovaya kislota or Trinitrofenol (cont'd)

Two methods of manufacturing Picric Acid are used in the USSR:

a) sulfonation & nitration of phenol.

b) nitration of chlorobenzene to dinitrochlorobenzene, hydrolysis to dinitrophenol, and subsequent nitration to Trinitrophenol (Picric Acid) using nitric-sulfuric acid.

Straight Picric Acid was used during WW II, to a limited extent, as a compressed bursting charge for some Shells & Bombs, in older types of Boosters, and as a base charge in some Detonators. It is also used in the form of its salts (Ammonium & Potassium Picrate), and in composite explosives, such as Frantsuzskaya smes' & Russkaya smes', which are loaded into Antitank Mines made of wood.

Pikrinovokislyi ammonii or Pikrat ammoniya — AMMONIUM PICRATE

See Pikrat ammoniya.

Piroksilin — NITROCELLULOSE

Russian Nitrocelluloses, having Nitrogen content of 12% and above, are called Piroksilin (Pyroxylin). Nitrocellulose of lower Nitrogen content (11.5-12.0%) is called Kolloksilin. Russian Piroksilin is subdivided into Piroksilin No. 1 having Nitrogen content of 13.0-13.5% and practically insoluble in ether-alcohol; and Piroksilin No. 2 of Nitrogen content 12.05-12.4% which is 90% soluble in ether-alcohol.

Piroksilins are now used for the preparation of smokeless Propellants. They were formerly used in compressed form (density 1.6 gm/cc), containing about 18% moisture, as bursting charges for Shells, Mines & Torpedoes, and in small Demolition Charges.

Pirotekhnicheskiye sostavy (Pyrotechnic Compositions) — PYROTECHNICS

Russian Pyrotechnic Compositions may be divided into four groups:

I. Pirotekhnicheskiye signaly (Pyrotechnic Signals)
II. Osvetitel'nyiye sostavy (Illuminating Compositions)
III. Trassiruyuschiye sostavy (Tracer Compositions)
IV. Zazhigatel'nyiye sostavy (Incendiary Compositions)

Pirotekhnicheskiye sostavy (cont'd)

I. Pyrotechnic Signals are divided into night signals (Signaly nochnogo deystviya) and day signals (Signaly dnevnogo deystviya). Examples of some night signal (flare) compositions are as follows:

Red light (Krasnyi ogon') - Potassium Chlorate 60%, strontium oxalate 25%, "Iditol" (synthetic resin binder similar to "Bakelite") 15% & ethyl alcohol (added) 3.5%.

Green light (Zelёnyi ogon') - a) Barium Chlorate 87%, "Iditol" 10%, paraffin 3% & ethyl alcohol (added) 2.5% & benzene (added) 3.0%.
b) Potassium Chlorate 63%, barium nitrate 25% & "Iditol" 12%.
c) Barium Chlorate 89-85% & "Iditol" (or shellac) 11-15%.

Yellow light (Zholtyi ogon') - Potassium Chlorate 40%, barium nitrate 20%, sodium oxalate 25%, "Iditol" 15% & ethyl alcohol (added) 2.5%.

Examples of some day signals or smoke signals (Dymovyye signaly) of various colors are as follows:

Red smoke (Krasnyi dym) - Potassium Chlorate 35%, rhodamine 20%, methyl orange 20%, sugar 17% & starch 8%.

Green smoke (Zelёnyi dym) - Potassium Chlorate 41.2%, methylene blue 37.5%, sugar 15.1% & "Iditol" 6.2%.

Yellow smoke (Zholtyi dym) - Potassium Chlorate 39.5%, auramine 26%, chrysoidine 14%, starch 14.5% & "Iditol" 6.0%.

Blue smoke (Scinii dym) - a) Potassium Chlorate 41.2%, methylene blue 37.5%, sugar 15.1% & "Iditol" 6.2%; b) Potassium Chlorate 35%, indigo 40% & lactose 25%.

II. Illuminating Compositions used in Grenades, Mortars or Shells are illustrated by the following:

a) barium nitrate 66%, magnesium powder 30% & "Iditol" or shellac 4%.
b) barium nitrate 68%, aluminum powder 28% & "Iditol" or shellac 4%.
c) barium nitrate 75%, aluminum powder 18%, magnesium powder 4% & boiled linseed oil 3%.
d) barium nitrate 80%, aluminum powder 15%, Black Powder 5% & boiled linseed oil (added) 6%.
These compositions are ignited by a "first fire" of: potassium nitrate 75-82%, magnesium 10-3% & "Iditol" 15% or potassium nitrate 75%, charcoal 15% & "Iditol" 10%.

III. Examples of Tracer Compositions are as follows:

a) Bright red (Krasnyi ogon') - strontium nitrate 60%, magnesium powder

30% & boiled linseed oil (or tar) 10%. Its burning rate is 3.1 mm/sec and candle power 2000.

b) White light (Belyi ogon') - barium nitrate 55%, magnesium powder 35% & shellac (rosin, or tar) 10%. Its burning rate is 3.0-4.7 mm/sec and candle power 2800-3800 (depending upon the binder used).

A typical igniting composition is illustrated by a composition consisting of: barium nitrate 48%, barium peroxide 30%, magnesium powder 13% & "Iditol" 9% or barium peroxide 80%, magnesium 18% & binder 2%.

These tracer & igniter compositions are used in all types of ammunition from 23-mm HE Shell to 120-mm HE Shell.

IV. Incendiary Compositions are of two types:

Class A or Thermite-type explosive - a) Potassium Perchlorate 55% & magnesium/aluminum alloy 45%; b) ferric oxide 50%, red phosphorus 30% & aluminum 20%; c) barium nitrate 50% & magnesium/aluminum alloy 50%; d) barium nitrate 44%, potassium nitrate 6%, ferric oxide (Fe_2O_3) 21%, aluminum 13%, magnesium 12% & binder 4%; and e) barium nitrate 26%, ferriferrous oxide (Fe_3O_4) 50% & aluminum 24%. Compositions a), b) & c) are used in rifle bullets and small-caliber shells designed mainly for igniting fuels. Composition d) is used in 76-mm Shells and Composition e) is used as a filler for Aerial Bombs.

Class B incendiary, not containing oxidizers, and/or of self-igniting type - a) "Electron Bomb", invented by the Germans, consists of a thick-walled Mg/Al shell filled with a special priming composition & aluminum/iron oxide mixture; b) organic combustible substances (gasoline, kerosene, tar and other hardened or thickened fuels); c) spontaneously igniting substances such as white phosphorus, hydrogen phosphide, hydrogen silicide & some organo-metal compounds.

An incendiary Hand Grenade contained a self-igniting mixture of yellow phosphorus dissolved in carbon disulfide. As soon as the carbon disulfide evaporated, the phosphorus ignited. The addition of oil or petroleum prolonged the time of burning. Thermite mixtures were also added sometimes to assure a higher temperature. Incendiary Shells used by the Soviets during WW II included 7.62-mm, 20-mm & 23-mm Small Arms; and 45-mm, 57-mm, 76.2-mm, 85-mm, 107-mm & 122-mm caliber Rounds.

See also Ruskii koktel'.

Plasticheskii dinamit (Plastic Dynamite) — DYNAMITE

See under Dinamit.

Pobedit — AMMONIUM NITRATE DYNAMIT POBEDIT

A coal mining explosive which is essentially an Ammonit (qv) to which 8-10% of Nitroglitserin (qv) is added. Several compositions are known. They are more sensitive to initiation and are more resistant to moisture than Ammonites. They are also not affected by low temperature as are Gelatin Dynamites (see Studenistyi dinamit or Zhelatin dinamit).

Russkaya smes' (Russian Mixture) — RUSSKAYA SMES'

This name was originally applied to a castable explosive composition also called Ammontol.

A. G. Gorst, "Porokha i Vzryvchatyiye Veshchestva" (Powders and Explosive Substances), Gos Izdat Oboron Prom, Moskva (1957), page 99 lists the current composition of Russkaya smes' as Picric Acid 51.5% & dinitronaphthalene 48.5% (also called Ruskii splav). It was used during WW II as a bursting charge in Antitank Land Mines, Bombs & Shells.

The Japanese used a similar composition, called Ōnayaku, as a bursting charge in Shells.

Russkii koktel' (Russian Cocktail) — RUSSKII KOKTEL'

An incendiary liquid consisting of Potassium Chlorate 80% & nitrobenzene (nitrololuene or nitroxylene) 20%. This mixture ignites when touched with a drop of concentrated nitric acid. It was used during WW II against tanks.

Ruskii splav (Russian Alloy or Fusion) — RUSSKAYA SMES'

Same composition as current Russkaya smes'.

Shedit — CHEDDITE

This explosive is not used in the USSR since Almatrit, which is stable and less sensitive than Cheddite, can be used for the same purposes.

Shneiderit | SCHNEIDERITE

This explosive was adopted by the Soviets from the French and has the approximate composition: Ammonium Nitrate 88% & dinitronaphthalene 12%. Its properties are reported as follows: Heat of explosion 921 kcal/kgm; temperature developed on explosion 2870°C; volume of gases evolved on explosion 918 liters/kg; and velocity of detonation 5100 meters/sec.

Examination, at Picatinny Arsenal during WW II, of a Soviet 76.2-mm HE Shell showed that it contained a bursting charge of Schneiderit, a booster of Tetryl and a booster surround of TNT.

See also Dinaftalit, Zernënyi; and Schneiderite under Japanese, Italian & French Explosives.

Shokoladnyi porokh or Buryi porokh | BROWN POWDER

See Buryi porokh.

Skal'nyi ammonit | AMMONITE

A press-loaded industrial explosive used for rock blasting. Skal'nyi ammonit No. 1 consists of a mixture of RDX, aluminum powder & calcium stearate. Skal'nyi ammonit No. 2 consists of RDX coated with Ammonium Nitrate.

See also Ammonit.

Sostavy zamedlennago deystviya (Delay Compositions) | BLACK POWDER

Delay compositions found in Soviet time-train fuze rings, examined at Picatinny Arsenal, were of Military-type Black Powder. Such a composition was used in the Fuze of 45-mm & 76.2-mm HE Armor-Piercing Shells, in 85-mm Incendiary Armor-Piercing Shells, and in 107-mm HE Shells.

See also Chornyi porokh.

Stifnat svintsa or Trinitroresorsinat svintsa (TNRS) | LEAD STYPHNATE

It is used in some Soviet Detonators as a separate top layer over Lead Azide but not mixed with it as in the USA.

Stifnat svintsa or Trinitro-resorsinat svintsa (TNRS)(cont'd) — LEAD STYPHNATE

See also Azido-tenerossovaya, Azid svintsa, Kapsiuli detonatory & Nakol'naya smes'.

Studenistyi dinamit (Gelatin Dynamite) — GELATIN DYNAMITE

See also Tetritol & Tetritol-Gheksoghen Brizantnoye VV.

Tetraeritrit nitrat (TEN) — PETN

Straight compressed PETN is used in the manufacture of Detonating Fuses(Detoniruyoushchii shnur) and as the base charge in some Detonator Caps (Kapsiuli detonatory). When desensitized or phlegmatized, it is used as a bursting charge in Shaped-Charge Projectiles. See Flegmatizirovannyi TEN.

A. G. Gorst, "Porokha i Vzryvchatyiye Veshchestva" (Powders and Explosive Substances), Gos Izdat Oboron Prom, Maskva (1957), pages 95, 98 & 100, reports that mixtures containing PETN (or RDX) with TNT or other explosives (or phlegmatizers) are also used in shaped-charged ammunition.

Tetrazen — TETRACENE

It is used as a substitute for Mercury Fulminate in some Priming Compositions (chiefly mixed with Lead Styphnate) for percussion caps. One such mixture is called Nakol'naya smes' (qv).

One source reports that Tetrazen plays the role of a phelgmatizer when mixed with Lead Styphnate, and 2-3% in admixture with Lead Azide increases its sensitivity to stab action.

Tetril — TETRYL

Its manufacture was begun in Russia in 1910. Straight Tetril is used compressed as a base charge in detonators, as a booster charge, and in some detonating-fuse compositions. Tetryl is also used phlegmatized, and in some composite explosives intended as bursting charges for Projectiles.

See Zhirov's Vzryvchatyye veshchestva.

Tetritol | TETRYTOL

Mixtures of Tetryl & TNT in various proportions similar to US compositions. They are castable explosives used as bursting charges in Projectiles and in Demolition Blocks.

Tetritol-Gheksoghen Brizantnoye VV (Vzryvchatoye veshchestvo) | PTX-1

A press-loaded (or cast-loaded), ternary explosive mixture consisting of RDX 71.9%, TNT 16.4% & Tetryl 11.7%. It is prepared by melting Tetrytol and adding the appropriate amount of RDX (Gheksoghen), or by adding the appropriate amount of Tetryl (Tetril) to RDX/TNT mixtures (called Composition B or Cyclotol in USA).

This explosive was used in 76.2-mm Armor-Piercing HE Shells, which contain an Incendiary Charge (of barium nitrate 38.9%, aluminum powder 46.1%, TNT 14.7% & sulfur 0.3%) press loaded into the point (nose).

The knowledge of employing ternary mixtures of explosives to obtain greater power & higher brisance than available with binary mixtures was gained by analysis at Picatinny Arsenal of Soviet 76.2-mm AP HE Shells.

US castable fillers, suggested by the Soviet mixture, are called PTX-1. They offer considerable advantages for military applications.

TNRS (Trinitroresorsinat svintsa) | LEAD STYPHNATE

See Stifnat svintsa.

Tol or Trotil | TNT

The first TNT plant was built in Russia about 1907. TNT is manufactured by either the batch method or a semi-continuous method as described by N. A. Shilling, "Vzryvchatyiye Veshchestva i Snariazheniye Boyepripassov" (Explosives and Loading of Ammunition), Oboronghiz, Moskva (1955), page 80.

Straight, cast TNT is used as a bursting charge in Shells (45-mm HE & 57-mm HE), Hand Grenades & Demolition Charges. Straight, pressed TNT is sometimes used as a booster surround in instances where the main bursting charge (such as in Shneiderit) is difficult to detonate by a booster alone. TNT is used also in a number of composite explosives such as Alumit 1; Amatol; Ammonal, Ammonit; Ammonit, Predokhranitel'nyi;

Tol or Trotil (cont'd) TNT

Ammontol; Flegmatizirovannyi trotil; K-1 splav; K-2 splav; L-splav; Tetritol; Tetritol-Gheksoghen Brizantnoye VV, and others.

Trassiruyuschiye sostavy PYROTECHNICS
(Tracer Compositions)
See under Pirotekhnicheskiye sostavy.

Trinitrofenol or Melinit PICRIC ACID
See Pikrinovaya kislota.

Trinitroresorsinat svintsa LEAD STYPHNATE
See Stifnat svintsa.

Trotil or Tol TNT
See Tol.

Udarnyiye or Initsiiruyushchiye sostavy PRIMER & INITIATING COMPOSITIONS

Most Soviet percussion priming and igniting compositions used in cartridge caps & fuzes consist of Mercury Fulminate, Potassium Chlorate & antimony sulfide with or without an abrasive added.

Some examples of current compositions are as follows:

I. Kapsiul vosplamenitel' (Ignitor Cap): a) for Rifle & Revolver - Mercury Fulminate 16.7%, Potassium Chlorate 55.5% & antimony trisulfide 27.8%; b) for Pistol (pistoletnyi) - Mercury Fulminate 25%, Potassium Chlorate 37.5% & antimony trisulfide 37.5%; c) for Minethrowing (minomëtnyi) - Mercury Fulminate 35%, Potassium Chlorate 40% & antimony sulfide 25%; d) for RGM Cap used in Detonating Fuze - Mercury Fulminate 50%, Potassium Chlorate 25% & antimony trisulfide 25%; e) non-corrosive percussion mixture (Nekorrodiruyoushchikh udarnykh sostavov) for rifle (montekristo) - Mercury Fulminate 67.8%, barium nitrate 29.6% & antimony sulfide 2.6%; and f) Needle-action or Pricking-action Composition - See Nakol'naya smes'.

II. Soviet pre-WW II Initiating Compositions consisted of a single charge of Lead Styphnate. Some of the current Detonators contain instead a top layer of Lead Styphnate (Stifnat svintsa), an intermediate layer of Lead Azide (Azid svintsa), and a bottom layer of Tetryl (Tetril), PETN (Tetraeritrit nitrat, abbreviated TEN), or RDX (Gheksoghen).

See also Kapsiuli detonatory.

Zazhigatel'nyiye sostavy (Incendiary Compositions) — PYROTECHNICS

See under Pirotekhnicheskiye sostavy.

Zhelatin dinamit or
Studenistyi dinamit (Gelatin Dynamite) — GELATIN DYNAMITE

Zhirova Vzryvchatyiye veshchestva — ZHIROV'S EXPLOSIVES

High-explosive mixtures based on Tetryl (Tetril) were patented in the USSR in 1927 as follows:

a) Tetryl 100 parts & Ammonium Perchlorate 150 parts are moistened with a mixture of ammonium hydroxide & acetone, ground, mixed & dried.

b) Tetryl 100 parts & Potassium Perchlorate 120 parts are treated as above.

[Ref: N. F. Zhirov, Russian Patent 4283 & 4284 (1927) and Chemical Abstracts 22, 4821 (1928)].

Unusual Research & Development in the Field of Explosives

"The Effect of Physical Structure and State of Aggregation on the Sensitivity of Explosives"

The question of the influence of physical factors on the detonation of explosives is of great theoretical interest since such questions and factors relate to many aspects of the mechansim of propagation of detonation. It is reported that liquid TNT detonates only if the diameter of the specimen is above 32 mm. Granular TNT, compressed to the same density as liquid TNT, detonates at diameters of 2.1 mm and above. The minimum (critical) diameters for Nitroglycerin are: Liquid NG 2.3 mm & solid NG less than 2.0 mm. Gas spaces between the explosive particles facilitates detonation, presumably because hot gases spread the detonation.

[Ref: A. Ya. Apin & V. K. Bobolev, Zhurnal Fizicheskoy Khimii (Journal of Physical Chemistry, Russia) 20, 1367-70 (1946) (in Russian) in Chemical Abstracts 41, 3297 (1947)].

Unusual Research & Development in the Field of Explosives (con't)

"An Electromagnetic Method Designed to Measure the Speed of Explosion Products"

The direct study of the speed of the explosion products is of great importance from the viewpoints both of the development of the theory of detonation and of the practical utilization of explosives.

A new method is described based on measuring the e.m.f. in a conductor moving in a magnetic field with explosion products. A copper or aluminum foil 0.3 to 0.5 mm thick is used as the conductor. The e.m.f. is recorded by means of a cathode-ray oscillograph, and the speed (U) is calculated from the equation:

$$U = (\epsilon/Hl) \times 10^8 \text{ cm/sec}$$

where ϵ = e.m.f.

H = magnetic field strength

l = conductor length

The experiments were carried out on samples of TNT and of 50/50 TNT/RDX (Trotil-Gheksoghen, abbreviated TG in Russian). The results obtained (with an accuracy within 3%) are somewhat lower, as a result of the condensation of ionized explosion products, than those results obtained by other methods.

[Ref: V.M. Zaitsev, P.F. Pokhil & K.K. Shvedov, Doklady Akademii Nauk (Proceedings of Academy of Science, Russia) 132, 1339-40 (1960)].

Unusual Research & Development in the Field of Explosives (con't)

"Mechanism of the Effect of Liquid Layer During Burning of Mixtures"

The combustion of Ammonium Perchlorate & potassium base mixtures as fusible and infusible fuels within a 1-350 atmosphere pressure range was investigated. I.A. Tereshkin had calculated that the temperature of combustion of Ammonium Perchlorate was 1580° K, that of a stoichiometric mixture of Ammonium Perchlorate with coke 3390° K and with paraffin 3280° K. The fuel & oxidizer were sifted thru an 025 screen. The particles of the Ammonium Perchlorate base mixture were less than 250μ. The paraffin mixtures were mixed with an oxidizer & paraffin solution in "boot" gasoline which was afterwards completely removed. When one of the mixture's components liquifies during combustion, the mixture burns according to the mechanism of individual explosive materials. A hypothesis is advanced on the liquid layer mechanism during combustion of mixtures.

[Ref: A.P. Glazkova, Zhurnal Fizicheskoy Khimii (Journal of Physical Chemistry, Russia) 37, No. 5, 1119-23 (1963)].

Unusual Research & Development in the Field of Explosives (con't)

"Study of the Transition to Detonation in the Combustion of Explosives at Elevated Pressures"

PETN, RDX, and tetryl explosive charges were used to determine the effect of grain size and density on the increase of combustion rate obtainable at pressures up to 1000 atm. Crystalline explosives of eight different average particle sizes ranging from 5 to 730μ were compacted into plexiglass tubes to densities of 0.28—1. The gas permeability of the specimens was determined and plotted against the density. The combustion rate was determined in a constant-pressure bomb filled with nitrogen. The combustion process was studied with a photoregister. Burning-rate-versus-pressure curves showed that at low pressures the combustion rate of powdered low-density explosives is the same as that of cast explosives. At critical pressure, a transition from normal to accelerated combustion occurred. The critical transition pressure increased with increasing density and decreased with increasing particle size. In PETN, the transition takes place at lower pressures than in the faster burning RDX. PETN (200μ particle size and 1.117 g/cm^3 in density) burned under 50 atm at the normal rate, but RDX under the same conditions burned ten times faster than the normal rate. The average burning rate under the accelerated regime was 10—100 times higher than the normal rate. The accelerated rate increased with increasing pressure and was a function of particle size and density. The transition from deflagration to detonation was not observed in the pressure range studied. The relative combustion stability of powdered explosives under elevated pressures depended primarily on the nitrogen gas concentration in the explosive. Accelerated combustion is discussed in terms of a mechanism involving the penetration of combustion products into the porous explosive.

[Ref: K.K. Andreyev & S.V. Chuyko, Zhurnal Fizicheskoy Khimii (Journal of Physical Chemistry, Russia) 37, No. 6, 1304-10 (1963)].

Unusual Research & Development in the Field of Explosives (con't)

"Combustion Mechanism of Nitroglycerin Powder and of RDX"

The distribution of light absorption and temperature along the axis of flames of nitroglycerin powder (Ballistite H) and RDX at pressures of $(220.5—440.1) \cdot 10^4$ newton/m^2 were measured in a constant-pressure bomb by an infrared pyrometer originally developed for temperature measurements at 600—3500°K. Three distinct zones were distinguished on the curves of temperature and absorption versus distance for the powder. Absorption decreased to a minimum in the first zone and increased in the second. In the third zone the temperature reached a maximum. Only two zones were observed for RDX; absorption decreased in the first and remained constant in the second. The results indicate that the condensed phase is dispersed during combustion at elevated pressures. In the combustion of the powder, the combustion efficiency and temperature increased continuously with pressure up to a maximum of 2350°K at $(490—539) \cdot 10^4$ newton/m^2. The length of the combustion zone decreased with increasing pressure. The temperature profile of the powder flame was S-shaped. Determination of heat release showed that in the condensed phase it increases with increasing pressure. The amount of heat released in the condensed phase and its role in heating of the charge, compared to the overall heat release, are greater for nitroglycerin powder than for RDX.

[Ref: P.F. Pokhil & V.M. Mal'tsev, Inzhenerno-Fizicheskii Zhurnal (Engineering-Physics Journal, Russia) 6, 94-99 (1963)].

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Spanish Explosives

The history of manufacturing explosives in Spain is one of the oldest in the world. Even after the loss of its colonies and sources of some raw materials, Spain continued to manufacture high-quality explosives & propellants. Soon after TNT was introduced in Germany as a military explosive (1902), Spain adopted TNT, almost simultaneously with Italy & Russia, for use by its Armed Forces. Many other nations of the world still continued to use Picric Acid at that time.

Today Spain uses a number of standard military & commercial explosives based on TNT, Picric Acid, Ammonium Nitrate, PETN, RDX, Tetryl & Nitroglycerin. La Sociedad Explosivos Alaveses, SA, Victoria is currently manufacturing Lead Azide, Mercury Fulminate, Tetracene & Lead Styphnate, and the Primer & Detonators employing these Primary Explosives.

The principal explosives known to be used are listed alphabetically in the following pages.

Aceite explosivo or Nitroglicerina — NITROGLYCERIN

See Nitroglicerina.

Ácido pícrico, Picrinita or Trinitrofenol — PICRIC ACID

See Picrinita.

Algodón fulminante or Algodón pólvora — GUNCOTTON

Amatex — AMATEX

See under Amatolo.

Amatolo — AMATOL

Various mixtures such as 90/10, 80/20, 70/30, 60/40, 50/50 & 40/60 Amatol are used. The 50/50 Amatol is used in projectiles and in mine & depth charges. Nitramita Española corresponds to US 80/20 Amatol.

Mixtures in which aluminum is added are called Minol (qv). Amatol sensitized by a small amount of Hexanitrodiphenylamine is called Amatex.

Amonal 1 — AMMONAL

A main burster charge developed in 1933 by Prof A. Blanko. It contains Ammonium Nitrate 92.4%, carbon 6.6% & aluminum 1%. During the Spanish Civil War (1936-39), it was used as a bomb filler and otherwise as a military explosive. Its properties are similar to those of 75% Dynamite, that is low brisance but comparatively high power. See Table 2 under AMMONAL.

Some similar compositions are called Amonal T, Amonal P, Sabulita, Nitramita de guerra, Eco, and Neanagón.

Amonita — AMMONITE

Amonitas are mixtures containing from 50 to 100% Ammonium Nitrate, other nitrated products and a small proportion of other

Amonita (cont'd)

substances such as Nitroglycerin, sawdust & dichromates. Some explosives of this type are called Explosivos Favier, Astralita, Roburita, Donarita & Perdita. Such mixtures are somewhat more sensitive to shock & friction and have a lower rate of detonation than other Ammonium Nitrate explosives. Their hygroscopicity and relative instability in prolonged storage are the principal disadvantages. They are used in mining operations and as main charges in some projectiles.

Astralita — ASTRALITE

See under Amonita.

Azida de plomo, Nitruro de plomo or Plumbazida — LEAD AZIDE

See Nitruro de plomo.

Baratol — BARATOL

This high-explosive bursting charge consists of barium nitrate 10-70% & TNT 90-30%.

This mixture is also used in Great Britain & in the USA.

Chedita or Cheddita — CHEDDITE

One composition reported consists of Sodium Chlorate 79%, Dinitrotoluene 16% & castor oil 5%. The properties of a typical Spanish Cheddite are: Loading density 1.3 gm/cc; velocity of detonation 3000 meters/second; heat of explosion 1185 cal/gm; temperature developed on explosion 4500°C; volume of gases at 0°C & 760-mm pressure 335 liters/kg; and brisance value 24 (TNT = 86).

See also Explosivo chloratado.

Ciclonita, Exógeno or T4 — RDX

See Exógeno.

Colodio or Piroxilina (Collodion Cotton) — NITROCELLULOSE

Dinamita — DYNAMITE

This general class of explosives is divided into two groups with variable compositions:

I. Dinamitas a base inerte (Dynamites with inert base). To this class belong the compositions containing 75, 50 or 30% Nitroglycerin & kieselguhr. They are called No. 1, 2 & 3 depending upon the Nitroglycerin content. Dynamite 3 is the most popular type.

II. Dinamitas a base activa (Dynamites with active base). These Dynamites contain a combustible material or explosive material as the active base. The type of base material used further divides these into classes:

a) Dinamitas a base de nitratos - Nitrates of Ammonium, sodium or potassium and a combustible such as carbon, sawdust or flour.

b) Dinamitas a base de chloratos - Chlorates of Potassium or Sodium are used in place of Nitrates.

c) Dinamitas gelatinas - Contain Collodion Cotton in sufficient proportion to gelatinize the Nitroglycerin. When the composition contains only Nitroglycerin & Collodion Cotton, it is called Goma. All others are called Gelatina dinamita, Nitrogelatina or simply Gelatina. If a Dynamite less sensitive than Gomas is desired, 3-5% of camphor is added. Such compositions are called Gelatinas explosivas de guerra (Military Gelatins).

All Spanish Dynamites are classed & manufactured as industrial explosives. The Goma pura (pure Goma) type, the most powerful, is used in underwater blasting; regular Goma, less powerful, is used in blasting hard rocks; all other types are used in demolition & general blasting operations.

Dinamita goma — BLASTING GELATIN

This explosive, described under Dinamita, has the following typical properties: Loading density 1.63 gm/cc; velocity of detonation 7500 meters/second; heat of explosion 1610 cal/gm; temperature developed on explosion 4460°C; volume of gases at 0°C & 760-mm pressure 711 liters/kg; and brisance value 148 (TNT = 86).

Dinamon — AMMONIUM NITRATE DYNAMITE DINAMON

This is an explosive similar to Amonita, except that it generally does not contain aluminum or aromatic nitrocompounds in its composition. They are called Dinamonitas numeros 1, 2 y 2 especial and Explosivos de seguridad numeros 2, 5 y 7.

They are brisant Dynamites, low-freezing and equal to or less in strength than Dinamita goma.

Donarita — AMMONIUM NITRATE DYNAMITE DONARITE

As an example of this type of Dynamite is the composition consisting of Ammonium Nitrate 80%, TNT 12%, Nitroglycerin (gelatinized) 4% & wood meal 4%. Its properties are reported as follows: Loading density 1.1 gm/cc; velocity of detonation 4000 meters/second; heat of explosion 930 cal/gm; temperature developed on explosion 2620°C; volume of gases at 0°C & 760-mm pressure 900 liters/kg; and brisance value 51 (TNT = 86).

See also Donarit under German Explosives.

Ecrasita — AMMONIUM TRINITROCRESYLATE

See Ecrasite under Italian Explosives and Ekrasit under Soviet Explosives.

Exógeno, Ciclonita or T4 — RDX

The properties of the pure RDX are reported as follows: Loading density 1.7 gm/cc; velocity of detonation 8380 gm/cc; heat of explosion 1500 cal/gm; temperature developed on explosion 3700°C; gas volume at 0°C & 760 mm pressure 908 liters/kg; and brisance value 188 (TNT = 86).

It is employed as a cover charge in Detonators having a base charge of Lead Azide; and when phlegmatized with paraffin, it is used in mining explosives & as a bursting charge in special Projectiles.

Exógeno plastico, Plastex or PE — COMPOSITION C

This is prepared by coating granular RDX with 12% of vaseline & other oily substances. The product is a yellow-colored plastic material which can be cut, perforated & handled without extra precaution. It is readily initiated by a Blasting Cap or various Detonators. In extreme climates, this explosive must be stored in protected areas.

It is used without any casing in some demolition applications.

Explosivo cloratado — CHEDDITE

This class of Cheddite-type explosives contains 60-80% of chlorates or perchlorates (of sodium, potassium or ammonium) with combustible materials (such as carbon, sulfur or aluminum), or organic substances such as vaseline, paraffin or oils.

Some examples of these explosives are called Chedita, and Cloratita, Coronita, Explosivos tipo O, Minelita & Trinolita (not described). Their properties are similar to those of Ammonium Nitrate Explosives, except they have higher densities & are somewhat more sensitive to impact. It is recommended that a strong Detonator such as No. 7 or 8 be used for their initiation.

Chlorate explosives such as Cheditas or Cloratitas can be used to advantage as substitutes for regular Dynamites in mining operations.

Explosivos de seguridad — AMMONIUM NITRATE EXPLOSIVES, PERMISSIBLE EXPLOSIVES

See under Dinamon.

Explosivos primarios y iniciadores — PRIMING AND INITIATING EXPLOSIVES

Because of the danger of using Mercury Fulminate Blasting Caps in gaseous mines, the following Priming & Initiating Compositions were developed by La Sociedad de Dinamita Nóbel:

a) Picric Acid 85%, Potassium Chlorate 5% & aluminum 10%

b) Trinitrocresol or Trinitroresorcinol (Styphnic Acid) 65% & Potassium Chlorate 35%

Explosivos primarios y iniciadores PRIMING AND INITIATING EXPLOSIVES (cont'd)

c) Trinitronaphthalene 45%, Dinitrophenol 10%, Mercury Thiocyanate 10% & Potassium Chlorate 35%.

d) Ammonium Nitrate 30%, Potassium Chlorate 42%, sulfur 10% & aluminum 18%.

The above compositions were used as substitutes for Mercury Fulminate.

Fulmicotón GUNCOTTON

Fulminato de mercurio MERCURY FULMINATE

It is used alone and in mixtures with Potassium Chlorate for charges in Primers & Detonators.

The properties of Mercury Fulminate are reported as follows: Loading density 4.42 gm/cc; velocity of detonation 5400 meters/sec. explosion temperature 180°C; impact sensitivity 2 kg weight 4 cm; heat of explosion 368 cal/gm; temperature developed on explosion 4450°C; volume of gases at 0°C & 760-mm pressure 315 liters/kg; and brisance value 128 (TNT = 86).

See also Explosivos primarios y iniciadores.

Gelatina dinamita GELATIN DYNAMITE

The properties of 60% Gelatina dinamita are reported as follows: Loading density 1.6 gm/cc; velocity of detonation 6100 meters/ second; heat of explosion 1295 cal/gm; temperature developed on explosion 3700°C; volume of gases at 0°C & 760-mm 630 liters/kg; and brisance value 148 (TNT = 86). See under Dinamita.

Goma BLASTING GELATIN

See under Dinamita.

Hexalita, Hexamina or Hexil — HEXANITRODIPHENYLAMINE

The properties of Hexamina are reported as follows: Loading density 1.67 gm/cc; velocity of detonation 7150 meters/second; heat of explosion 1035 cal/gm; temperature developed on explosion 3450°C; volume of gases at 0°C & 760-mm pressure 675 liters/kg; and brisance value 111 (TNT = 86).

This high explosive is used in admixtures with TNT to form a castable bursting charge for Grenades, Mines & Torpedoes.

See also Amatex.

Hexonita — HEXONITA

This is a very powerful explosive composition consisting of a mixture of RDX 80% & Nitroglycerin 20%. A composition consisting of RDX, PETN & Nitroglycerin is also reported. The basic explosive can be gelatinized further & plasticized by the addition of Collodion Cotton to give a composition consisting of RDX 50%, Nitroglycerin 46% & Collodion Cotton 4%. This composition is called Hexonita gelatinizada.

See also Pentrinita.

Iniciadores explosivos — INITIATING EXPLOSIVES

See Explosivos primarios y iniciadores.

Macarita — PLUMBATOL

Same as Belgian Explosive called Macarite.

MAT — MAT; PICRATOL

Same as Italian Explosive having this designation.

It was used as a bursting charge in ammunition.

MBT — MBT

Same as Italian Explosive having this designation.

It was used as a bursting charge in ammunition.

MDN — MDN

Same as French Explosive having this designation.

It was used as a bursting charge in ammunition.

MDPC — MDPC

Same as French explosive having this designation.

It was used as a bursting charge in ammunition.

Minolex — DBX MINOLEX

A castable explosive composition consisting of TNT 40%, RDX 20%, Ammonium Nitrate 20% & aluminum 20%.

It was used as a bursting charge in ammunition.

MMN — MMN

Same as French Explosive having this designation.

It was used as a bursting charge in ammunition.

MTTC — MTTC

Same as French Explosive having this designation.

It was used as a bursting charge in ammunition.

Nitramita Española — AMATOL

Nitrato amónico — AMMONIUM NITRATE

The properties of Ammonium Nitrate are reported as follows: Loading density 1.1 gm/cc; velocity of detonation 2500 meters/second;

Nitrato amónico (cont'd)

heat of explosion 350 cal/gm; temperature developed on explosion 1230°C; volume of gases at 0°C & 760-mm pressure 980 liters/kg; and brisance value 13 (TNT = 86).

It is used primarily in composite explosives such as Amatolo, Amonal, Amonita & Donarita.

Nitrocelulosa or Piroxilina — NITROCELLULOSE

Nitrogelatina — GELATIN DYNAMITE

See under Dinamita.

Nitroglicerina or Aceite explosivo — NITROGLYCERIN

The properties of Nitroglycerin are reported as follows: Loading density 1.6 gm/cc; velocity of detonation 7400 meters/second; heat of explosion 1485 cal/gm; temperature developed on explosion 4250°C; volume of gases at 0°C & 760-mm pressure 716 liters/kg; and brisance value 145 (TNT = 86).

Nitroglycerin is used in a number of composite explosives such as Dinamita, Hexonita, Pentrinita.

Nitropenta, Nitropentaeritrita or Pentrita — PETN

See Pentrita.

Nitruro de plomo or Azida de plomo — LEAD AZIDE

The properties of Lead Azide are reported as follows: Loading density 4.6 gm/cc; velocity of detonation 5300 meters/second; heat of explosion 260 cal/gm; temperature developed on explosion 3450°C; volume of gases at 0°C & 760-mm pressure 310 liters/kg; and brisance value 107 (TNT value = 86).

Lead Azide is used alone & in mixtures with other salts of lead in the preparation of Initiating Explosives & Detonating Compositions.

Pentolita or Pentritol — PENTOLITE

A castable composition consisting of PETN 50% & TNT 50%.

It corresponds to British & US Pentolite and was used as a booster & as a bursting charge in ammunition.

Pentrinita — PENTRINITA

This is a very powerful explosive composition consisting of a mixture of PETN 70% & Nitroglycerin 30%. This composition can also be gelatinized further & plasticized by the addition of Collodion Cotton to give a composition consisting of PETN 50%, Nitroglycerin 46% & Collodion Cotton 4%. Such a composition is called Pentrinita gelatinizada.

The properties of 70/30 Pentrinita are reported as follows: Loading density 1.72 gm/cc; rate of detonation 8400 meters/second; heat of explosion 1480 cal/gm; temperature developed on explosion 4120°C; volume of gases at 0°C & 760 mm pressure 770 liters/kg; and brisance value 178 (TNT = 86).

See also Hexonita.

Pentrita, Nitropenta or Nitropentaeritrita — PETN

The properties of PETN are reported as follows: Loading density 1.7 gm/cc; velocity of detonation 8600 meters/second; heat of explosion 1526 cal/gm; temperature developed on explosion 4248°C; volume of gasea at 0°C & 760-mm pressure 780 liters/kg; and brisance value 193 (TNT = 86).

Straight PETN is used in several composite explosives such as Hexonita, Pentolita, Pentrinita & others. When phlegmatized with 5-10% of paraffin, it is used as a bursting charge in Aircraft Projectiles, and in Demolition & Mining Charges.

Picrato amónico — AMMONIUM PICRATE

Picrinita, Ácido pícrico or Trinitrofenol — PICRIC ACID

The properties of Picric Acid are reported as follows: Loading density 1.69 gm/cc; velocity of detonation 7250 meters/second; heat of explosion 1000 cal/gm; temperature developed on explosion 3230°C; volume of gases at 0°C & 760-mm pressure 675 liters/kg; and brisance value 107 (TNT = 86).

It was used pressed as the core of Detonating Cord (Mecha rápida or Mecha detonante). It was also used in composite military explosives.

Pirotecnias & Artificios (Fireworks) — PYROTECHNICS

Spanish Pyrotechnic compositions are divided into several distinct groups as follows:

a) Producción de luz (Light production). These are subdivided into illuminating, colored, sparking & double compositions.

b) Producción de gases (Gas production). These are subdivided into flying parachute, smoke, disinfecting smokes & extinguishers.

c) Producción de una llama viva y a una temperatura elevada (Intense flame & high-temperature production). These are incendiaries, combustible mixtures with oxidizers & flammable liquids.

Many Pyrotechnic compositions & applications are listed by both E.E. Sancho, "Química des Los Explosivos", Agudo, Madrid (1941), pages 351-60; and M. Vivas, R. Feigenspan & F. Ladreda, "Pólvoras y Explosivos Modernos", Morata, Madrid, volume 2 (1946), pages 357-70, but these authors do not specify which are Spanish developments or which are used in Spain.

Piroxilina, Nitrocelulosa or Colodio (Collodion Cotton) — NITROCELLULOSE

Plastrita — PLASTRITA

This is an experimental explosive consisting of granular TNT & Collodion Cotton. The composition is a plastic paste which was found to be inferior to straight TNT.

Ploplastrita or Plomoplastrita — PLOPLASTRITA

This explosive consists of a mixture of pulverized TNT, Collodion Cotton & lead nitrate, or Plastrita & lead nitrate. The composition is less sensitive than TNT & is equal in power to TNT, weight by weight, but is considerably more powerful on an equal volume basis due to its high density. Another advantage is that it does not produce any noxious gases on detonation.

Ploplastrita was developed for use as a bursting charge in Artillery Shells, Grenades & in mining.

Pólvora negra — BLACK POWDER

Spanish Black Powders vary in composition & uses as follows:

Pólvora de caza (Sporting Powder) - potassium nitrate 80%, charcoal 11% & sulfur 9%.

Pólvora de guerra (Military Powder) - potassium nitrate 75%, charcoal 12.5% & sulfur 12.5%.

Pólvora de mina (Blasting Powder) - potassium nitrate 62%, charcoal 18% & sulfur 20%.

In general, Black Powder is ignited by spark or hot iron and, more difficultly, by flame or percussion. Its temperature of ignition varies between 270° — 320°C. It is very sensitive to initiation by friction, and the hygroscopicity of the powder is inversely proportional to the size of the grains.

The properties of a typical Black Powder composition are as follows: Loading density 1.2 gm/cc; velocity of detonation 400 meters/second; heat of explosion 665 cal/gm; temperature developed on explosion 2380°C; volume of gases at 0°C & 760-mm pressure 280 liters/kg; and brisance value 1.4 (TNT = 86).

Sabulita — SABULITA

This is a military & industrial explosive which consists of Ammonium Nitrate 78%, TNT 8% & calcium silicide 14%, added to increase the heat of explosion of the mixture. This mixture is called Sabulita número 0 or 1 depending upon the calcium silicide content (14 or 12%). The name Sabulita is also applied to mixtures containing 8-9.5% Potassium Perchlorate in place of some of the Ammonium Nitrate.

Tetraceno — TETRACENE

This compound is obtained as a yellow, fluffy solid, insoluble in water. Its explosion temperature is 137-140°C.

Tetracene is used as an Initiating Explosive.

Tetralita, Tetranitrometilanilina or Tetrilo — TETRYL

The properties of Tetryl are reported as follows: Loading density 1.65 gm/cc; velocity of detonation 7250 meters/second; heat of explosion 1090 cal/gm; temperature developed on explosion 3370°C; volume of gases at 0°C & 760-mm pressure 710 liters/kg; and brisance value 116 (TNT = 86).

Tetryl is used as a base charge in Primers & Detonators and as the core of Detonating Cord (Mecha rápida or Mecha detonante).

Tetritol — TETRYTOL

This composition consists of Tetryl 75% & TNT 25%.

It is a castable bursting charge used in various Projectiles.

Tonita — TONITA

This explosive consists of a mixture of barium nitrate 68%, Dinitrobenzene 13% & Gun cotton 19%.

It was used as a bursting charge in ammunition.

Torpex or Tritolital — TORPEX

See Tritolital.

Tricinato or Trinitroresorcinato de plomo — LEAD STYPHNATE

See Trinitroresorcinato de plomo.

Tridita | TRIDITE

A castable explosive mixture of Picric Acid 80% & Dinitrophenol 20%.

It was used as a bursting charge in Shells & Bombs.

The British used a similar mixture called Nellite, the French mixture is called DD (Explosif), and the Italian MBT.

Trilita, Trinitrotolueno, Trinitrotoluol or Trotilo | TNT

The properties of Trilita (TNT) are reported as follows: Loading density 1.59 gm/cc; velocity of detonation 6800 meters/second; heat of explosion 1000 cal/gm; temperature developed on explosion 2800°C; volume of gases at 0°C & 760-mm pressure 690 liters/kg; and brisance value 86.

TNT is a standard explosive in Spain but it is not used as a mining explosive because on detonation noxious gases are produced. It is used as a bursting charge in Mines, Projectiles, Bombs & in Demolition work. It is used as a base charge in Primers & Detonators, Nos. 0-5. TNT is also employed in a number of composite explosives such as Amatex, Amatolo, Amonal, Baratol, Donarita, Minolex, Pentolita, Plastrita, Tetritol, and others.

Trimonita | TRIMONITE

This castable explosive consists of a mixture of Picric Acid 90% & mononitronaphthalene 10%.

Trinitrofenol, Ácido pícrico or Pircrinita | PICRIC ACID

See Picrinita.

Trinitroresorcinato de plomo or Tricnato (Triginato) | LEAD STYPHNATE

The properties are reported as follows: Dark yellow crystals; density 3.1 gm/cc; velocity of detonation 5200 meters/second; explosion temperature 275-80°C; and impact sensitivity with 2-kg weight 7 cm.

Trinitroresorcinato de plomo (cont'd)

It is used in admixture with Potassium Chlorate as an Initiating Explosive in place of Mercury Fulminate. It is also used in mixtures with Lead Azide in Detonator Caps.

Trinitrotolueno, Trinitrotoluol, Trotilo or Trilita — TNT

See Trilita.

Triplastita — TRIPLASTITA

This is a gelatinized explosive consisting of Dinitrotoluene & Collodion Cotton. The product is less sensitive than TNT and has the advantage of a higher density when compressed.

It was used as a bursting charge in ammunition.

Tritolita — CYCLOTOL

This castable explosive corresponds to US 50/50 RDX/TNT, called Cyclotol.

It was used as a bursting charge in ammunition.

Tritolital or Torpex — TORPEX

This castable explosive consists of TNT 60%, RDX 20% & aluminum 20%.

It was used as a burstingcharge in ammunition.

Unusual Research & Development in the Field of Explosives

"New Methods in the Production of Arms and in the Development of Explosives" (New Launching Devices)

The leading country, as far as new Mortars are concerned, is Spain where the firm of Esperanza y Compañía in Marquina has introduced three new Mortars. These Mortars differ from one another only in size, weight & caliber (60-, 81- & 120-mm) but are absolutely alike in all other respects. Personnel trained in operating any one of these types can immediately use or service any of the other types.

One significant feature of these Mortars is their aiming device which was developed thru Spanish-German cooperation. It is possible to adjust the Mortars with great speed & accuracy. Their accomplishments are considerable. One can fire as far as 1700 meters with the 60-mm Mortar; 3150 meters with the 81-mm Mortar; and 6400 meters with the 120-mm Mortar. The 81-mm Mortar has been introduced into the Spanish, Portuguese, Turkish & Egyptian Armies. The 60-mm Mortar is also used by the police squads of several European countries.

Of great advantage is the Mortar's wide field of fire which extends from 45 to 85 degrees in elevation, and which amounts laterally — without moving the tripod — to 15 degrees on each side at mean quadrant elevation. By moving the tripod laterally, it is possible to cover a front latitude of 360 degrees. The ESPERANZA tripod is a construction feature which is absolutely uncommon for Mortars. Due to this special feature it is not necessary to install shock absorbers on the legs of the Mortar Carriage. This influences the price of the weapon favorably, and also eliminates the requirement to constantly adjust the Mortar.

The firm of Instalaza in Saragossa has introduced a new Spanish Bazooka, an 88.9-mm Launcher. This weapon is used by the Spanish & Portuguese Armed Forces, and has recently been demonstrated to NATO forces, where excellent results were achieved under the most unfavorable conditions. The weapon fires Armor-Piercing, Hollow-Charge & High-Explosive Shells, and thus represents a valuable accompanying weapon of the infantry. It can also use all American grades of ammunition intended for the 3.5-inch Bazooka.

The range of this Launcher, 1000 meters, is considered good in view of its weight of only 8 kg. The Launcher is serviced by only one man who can fire it while standing, kneeling, sitting or lying down. The explosive charge consists of a mixture of TNT & RDX, but may also be compressed RDX which further increases the penetrative power.

Unusual Research & Development in the Field of Explosives (cont'd)

The firm of Hispano-Suiza has developed several New Rocket Launchers. At the present time a Launcher is being built for 8-cm Rockets. It is intended, however, that this R-80-T Artillery Ground Rocket become the forerunner of an entire family of 12-cm, 15-cm or even 21-cm Caliber Rockets. The Rockets can be supplied with various demolition charges of 5-9 kg. Their range is 9.5 kilometers. The cross-shaped propelling charge, which consists of a new kind of powder and is ignited electrically, assures an extraordinary degree of steadiness in flight. The Italian Navy, which assisted the manufacturer during firing tests in the Gulf of Naples, seemed highly impressed with the performance of both the Launcher & the Rockets.

[Ref: Anonymous, "Neue Wege im Waffenbau und in der Entwicklung von Sprengkörpern. Neue Werfer", Wehr und Wirtschaft No 12, Stuttgarter Verlagskontor GMBH, Stuttgard, Germany (December 1959) (Ordnance Technical Intelligence Translation H-5716 by E.R. Mullinax, OTIA 5904)].

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Swedish Explosives

The explosives industry of Sweden dates from the year 1540. For over 300 years, the manufacture of explosives was limited to Black Powder & similar compositions. The inventions of Alfred Nobel, of various Dynamites, in the 1860-70's, soon led to the emergence of a modern explosives industry. By 1900 all of the firms, which are major producers today, had been established.

The industrial & military explosives industry of today consists of both private- and government-owned facilities. Together they provide virtually all of the country's explosives, plus significant amounts for export. The only items obtained abroad are initiating components such as Primers & Detonators. Sweden, however, is heavily dependent on imports for certain basic raw materials such as petroleum, coal, coke, cotton, sulfur, and others.

Commercial explosives are used extensively for mining, excavating & road building. Also large quantities are used in excavation for underground shelters & other facilities. Dynamites are also used by the military forces as standard Demolition Charges. A broad range of military explosives are currently being produced. These include TNT, RDX, PETN, Composition B, Torpex, Black Powder, Lead Azide, Lead Styphnate, Mercury Fulminate and Propellants (all types).

There are seven significant producers of explosives & related items. Three of these plants are government owned. All are located in southern Sweden. The largest individual producer of military explosives is AB Bofors Nobelkrut, a division of AB Bofors of Karlskoga. AB Nitroglycerin in Gyttorp is the principal producer of commercial explosives. Åkers Krutbruk in Åker is the only government plant which manufactures bulk explosives.

The principal explosives known to be manufactured & used in Sweden, according to available native nomenclature, are listed alphabetically in the following pages.

Ammongelatin Dynamit | GELATIN DYNAMITE

This type of explosive was invented in 1879 by A. Nobel. One formulation contains Nitroglycerin 71%, Collodion Cotton 4%, Ammonium Nitrate 23% & charcoal 2%. Another contains Nitroglycerin 25%, Collodion Cotton 1%, Ammonium Nitrate 62% & charcoal 12%. The first composition is gelatinous, while the second is crumbly & plastic but not gelatinous.

The basic formulations may be and have been changed by incorporating other explosives such as liquid Dinitrotoluene, TNT, Trinitroxylene, Nitrostarch or Nitroglycols. Such additives act not only as sensitizers for Ammonium Nitrate but some also serve as antifreeze compounds.

This Dynamite is used for general blasting & demolition operations.

Dynamites similar to Ammongelatin dynamit are manufactured in the USA by the DuPont Company under the name Extra Dynamite.

Ammoniakkrut | AMMONIAKKRUT
AMMONIUM NITRATE DYNAMITE

This explosive, invented in 1876 by Swedish chemists C.J. Ohlsson & J.H. Norrbin, consisted of Ammonium Nitrate 80% & charcoal 20%. Such a mixture is the first known explosive based on Ammonium Nitrate. The original mixture was difficult to initiate and was replaced by Nobel by one consisting of Ammonium Nitrate 80%, Nitroglycerin 12% & charcoal 8%. This modified composition is more powerful than Guhrdynamit consisting of the same amount of Nitroglycerin.

The modified Ammoniakkrut has been used to some extent in Sweden but was found to be too hygroscopic & exudable. A better explosive, in which the Ammonium Nitrate is coated with gelatinized Nitroglycerin, is known as Ammongelatin Dynamit.

See also Seranin.

Ammoniumnitrat | AMMONIUM NITRATE

It is used in a number of commercial explosives such as Ammongelatin dynamit, Ammoniakkrut, Dynamit, Nobelit, Seranin and others.

Blastin — CHEDDITE

This is a safety explosive consisting of Ammonium Perchlorate 63%, sodium nitrate 23%, Dinitrotoluene 8% & paraffin wax 6%. It is reported to be 50% more powerful than Dynamite. Blastine has been used extensively as a blasting & demolition explosive.

It is reported that a British explosive, called Blastine, consists of Ammonium Perchlorate 60%, sodium nitrate 22%, TNT 11% & paraffin 7%. This composition is very similar to the Swedish Blastin.

Blyazid (Blyacid) — LEAD AZIDE

Lead Azide has replaced Mercury Fulminate in many Detonators for military ammunition and in commercial Blasting Caps. It is not used in parts of Primers or Fuzes made of copper or brass because of its tendency to form the highly sensitive Copper Azide.

For purposes where a higher sensitivity is desired, Lead Azide is covered with a layer of Lead Styphnate or mixed with this more sensitive initiator. Lead Azide is used both pure & dextrinated.

Blystyfnat or Blytrinitroresorcinat — LEAD STYPHNATE

This is a finely divided, rhombic explosive, light orange or reddish brown in color. It crystallizes with one-half mole of water of crystallization. When brought in contact with a flame or subjected to impact, Lead Styphnate explodes with a loud report. It is less sensitive to impact & friction than either Mercury Fulminate or amorphous Lead Azide but is more sensitive to heat than Lead Azide. The compound is of a high order of stability.

Lead Styphnate has been found incapable of initiating the detonation of either TNT or Tetryl, but can cause the detonation of unpressed PETN. It will initiate straight 40% Dynamite but not non-uniformly Gelatin Dynamite. It is used as a cover charge for Lead Azide, as a primary initiator in bridge-wire Detonators, and in various Priming Compositions required to have certain blast characteristics.

Bonit | BONIT CYCLOTOL

This name is applied to Swedish military explosives developed by AB Bofors Nobelkrut. The following mixtures were used before WW II:

Bonit 1. RDX 50% & TNT 50%. Its loading density is 1.68 gm/cc; velocity of detonation 7600 meters/second; and heat of explosion 1130 cal/gm.

Bonit 2. RDX 70% & TNT 30%. Its loading density is 1.70 gm/cc; velocity of detonation 7800 meters/second; heat of explosion 1225 cal/gm (TNT = 850); gas volume at NTP 950 liters/kg (TNT = 630); relative brisance 136% (TNT = 100); and Trauzl test value 421 cc (TNT = 290).

Bonit 3. RDX 60% & TNT 40%. This is the usual & most common mixture used. Its properties are intermediate between those of Bonit 1 & Bonit 2. See also Hexotol.

Bonit was used as an underwater military bursting charge. At present it is used as a bursting charge in Shells. During WW II aluminum powder was incorporated into Bonit to increase its effectiveness. Such a mixture is called Hexotonal.

Bonocord | DETONATING FUSE PRIMACORD

The Swedish Detonating Cord consists of a core of PETN, covered with braided cotton threads, and protected by an outer coating of a plastic which is based on polyvinyl chloride or polythene. The quantity of PETN is 12 grams per meter; the total weight of Bonocord is 30 gm/meter, and its outer diameter is 5.5 millimeters. Bonocord has a detonation velocity of 6000-7000 meters/second. It is initiated with a No 6 Exploder and is used for direct detonation of all kinds of explosive charges.

Dynamit | DYNAMITE

Dynamites with active bases, now called "Straight Dynamites" and which correspond to present formulations, were first prepared by A. Nobel in 1869. Nobel coated the particles of a mixture of

Dynamit (cont'd)

oxidizers (potassium, sodium or Ammonium Nitrate) & solid combustibles (such as woodmeal, charcoal, rosin, starch or sugar) with Nitroglycerin. The patent suggested a mixture of barium nitrate 70%, rosin or charcoal 10% & Nitroglycerin 20%. Sulfur could be either added or omitted.

When sodium or Ammonium Nitrate was used, it was suggested that the particles be coated with small amounts of paraffin, ozokerite, stearine, naphthalene or other similar substances, in order to reduce the hygroscopic nature of the oxidizer. Formulations such as proposed by Nobel are still in use today. Straight Dynamites are easily detonated by a Mercury Fulminate Blasting Cap.

A variety of compositions of Dynamites are manufactured in Sweden by AB Bofors Nobelkrut at Karlskoga, by Nitroglycerin AB at Gyttorp, by AB Norma Projektilfabrik at Åmotfors, by AB Nora Tändrörsfabrik at Nora, by AB Svenska Krutfaktorierna at Landskrona, and probably by other plants.

See also Ammongelatin Dynamit, Ammoniakkrut, Gelatinerad Dynamit & Spränggelatin.

Flegmätiserat Sprängämne — PHLEGMATIZED EXPLOSIVES

This name is applied to Swedish explosives which have been phlegmatized (desensitized) by coating the granules with wax. The desensitizing wax used is a white, semi-transparent, highly refined petroleum paraffin.

See uses under Hexogen & Pentyl.

Gelatinerad Dynamit — GELATIN DYNAMITE

This explosive was invented in 1875 by A. Nobel. He dissolved small amounts of Collodion Cotton in slightly warmed Nitroglycerin and incorporated into the resulting soft jelly some Black Powder, saltpeter (potassium nitrate) or woodmeal. A typical Dynamite contained Nitroglycerin 62.5%, Collodion Cotton 2.5%, potassium nitrate 27% & woodmeal 8%. Present commercial Gelatin Dynamites are essentially unchanged in formulation from the original inventions of Nobel, except that Black Powder as such is not added.

See also Spränggelatin and Ammongelatin Dynamit.

Hexanitrodifenylamin | HEXANITRODIPHENYLAMINE

It was used in some composite high-explosive bursting charges such as Novit.

Hexogen | RDX

Due to its properties, which have been thoroughly investigated in Sweden, RDX is used primarily with other explosives to form mixtures that can be either pressed or cast as safely as TNT. The principal compositions are Hexotol or Bonit & Hexotonal.

RDX desensitized with a small quantity of wax is used as a bursting charge in some Shells. It is also transformed into a Plastic Explosive (Sprängdeg) for various uses by incorporating special plasticizers, not further identified.

Hexotol | CYCLOTOL HEXOTOL

This name is applied to the usual & most common mixture of RDX & TNT (60/40). It is prepared in the form of beads, pellets, flakes or granules. This explosive is also called Bonit 3.

It is used as a cast bursting charge in Shells, Land Mines, Demolition Charges, Boosters, and in other military applications.

See also Hexotonal.

Hexotonal | HEXOTONAL TORPEX

This name is applied to several castable explosives developed by AB Bofors Nobelkrut. They are usually prepared by adding small proportions of wax, carbon black in some formulations, and aluminum powder to 60/40 or 50/50 Hexotol (Bonit). Some examples of known compositions are as follows:

a) RDX 40%, TNT 44%, aluminum 15% & wax (highly refined petroleum paraffin) 1%

b) RDX 40%, TNT 40%, aluminum 15% & wax 5%

c) RDX 30%, TNT 50% & aluminum 20% plus 1% wax & 1.5% carbon black.

Hexotonal (cont'd)

Hexotonals were used during WW II as very effective underwater military explosives. At present these explosives are used as bursting charges in many types of ammunition such as 40/70-mm HE Shell, 57-mm Shell, 375-mm A/S Rocket and others.

Knallkvicksilver — MERCURY FULMINATE

Mercury Fulminate consists of white to grey octahedral crystals. It is considered to be one of the most sensitive of the primary explosives to impact, friction & heat. The disadvantages of Mercury Fulminate are its high price & unsatisfactory stability.

The standard grade of Mercury Fulminate (98-99% pure) deteriorates significantly even at 30-35°C, but will remain of satisfactory purity & initiating value for some years if the storage temperature is not greater than 20°C. Mercury Fulminate purified to 99.75% is definitely more stable. When the material is less than 90% pure, its initiating efficiency is completely lost.

Although Lead Azide is being substituted for Mercury Fulminate in many applications, it is reported that Mercury Fulminate is still used in commercial Blasting Caps & in some military ammunition.

Nitrocellulosa — NITROCELLULOSE

Nitroglycerin — NITROGLYCERIN

This colorless-to-pale-yellow oily liquid is reported to crystallize in two allotropes: A stable form freezing at +13.0-13.5°C and an unstable form freezing at +2.0-2.5°C. Its properties have been determined and reported in detail. They are similar to US data.

Nitroglycerin forms with Nitrocellulose the basis for the manufacture of double-base Propellants. It is also used in a variety of industrial explosives such as Dynamites. Small quantities of Nitroglycerin are also used in medicine as a depressor of blood tension.

Nobelit — GELATIN DYNAMITE NOBELIT

A permissible Gelatin Dynamite consisting of Nitroglycerin 28%, Collodion Cotton 1%, Ammonium Nitrate 40%, combustibles (flour, woodmeal, dextrin) 13.5%, sodium chloride 17% & vegetable oil 0.5%.

See also Nobélite under French Explosives and Nobelit under German Explosives.

Novit — NOVIT

This underwater explosive, invented before WW I, originally consisted of TNT 50% & Hexanitrodiphenylamine 50%. Its properties are: Loading density 1.67 gm/cc (TNT = 1.65); velocity of detonation 7200 meters/second (TNT = 6800); heat of explosion 1000 cal/gm (TNT = 950); relative brisance 103% (TNT = 100); and power by Trauzl test 315 cc (TNT = 290).

A similar mixture, in the proportions 60/40, 50/50 or 40/60 TNT/Hexanitrodiphenylamine, was used by the Germans under the name Hexamit, and by the Japanese under the name Seigata or Type 97H.

During WW II some pulverized aluminum powder was incorporated into Novit to increase its underwater effectiveness. This explosive consists of TNT 56%, Hexanitrodiphenylamine 28% & aluminum 16%. It was used in all types of underwater ammunition.

A similar mixture was used by the Germans under the name Schiesswolle 18 or TSMV1-101, and by the Japanese under the name A (ko), Type A or Otsu-B.

Pentyl — PETN

PETN is obtained as non-hygroscopic, colorless, prismatic crystals melting at 142°C. The technical grade melts at 140-141°C.

Besides Nitroglycerin & Nitrocellulose, PETN is considered the most important of the nitric esters in the field of explosives. In the pure state, PETN is used to form the core of Detonating cord (Bonocord), and is used as a base charge in Blasting Caps. In admixtures with Nitroglycerin, PETN is used in a variety of

Pentyl (cont'd)

industrial explosives called Pentrinits. PETN desensitized with wax is used as a bursting charge for Shells, Boosters & Demolition Blocks. By the addition of special components, PETN forms plastic explosives called Sprängdeg.

In some applications, both industrial & military, PETN is considered to have a serious rival in the more stable and less expensive RDX & RDX compositions.

Pikrinsyra PICRIC ACID

The specific uses of Picric Acid in Swedish explosives are not known.

Pyroteknik PYROTECHNICS

A brief description of the historical development of Pyrotechnics in Sweden is given by A. Lotz, "Das Feuerwerk", Hiersemann, Leipzig (1940), page 106.

Seranin SERANIN AMMONIUM NITRATE DYNAMITE

Soon after the invention of the Swedish explosive Ammoniakkrut (qv), Bjoerkmann patented (June 1867) a blasting explosive consisting of Ammonium Nitrate 72.5%, Nitroglycerin 18%, sawdust or charcoal 8.7% & benzene or creosote 0.8%. Seranin, like the modified Ammoniakkrut containing Nitroglycerin, was more powerful than the Guhrdynamite invented earlier by A. Nobel.

This explosive has been used to some extent in Sweden but is being replaced, for certain blasting operations, by Ammonium Nitrate explosives coated with gelatinized Nitroglycerin called Ammongelatin Dynamite.

Sprängämnen med Minverkan DEMOLITION EXPLOSIVES

See Ammongelatin dynamit, Blastine, Dynamit, Gelatinerad dynamit, Nobelit, Seranin, Spranggelatin, Territ, and others.

Sprängdeg

PLASTIC EXPLOSIVE

This name is applied to Swedish plastic explosives, usually of RDX or PETN which has been desensitized by oil & special plasticizers.

The Bofors Plastic Explosive consists of PETN 84% & mineral oil 16% mixed by a special procedure. The product is a yellow plastic dough having a bulk density of 1.45 gm/cc. It is moldable even at temperatures below -15°C, and is of the same order of stability as crystalline PETN.

Plastic Explosives are used for both industrial & military purposes.

Spränggelatin

BLASTING GELATIN

This explosive was invented in 1875 by A. Nobel. It is prepared by dissolving 7-8% of Collodion Cotton in slightly warmed Nitroglycerin. The resulting product on cooling is a stiff jelly. It is one of the most powerful industrial explosives known, even today.

See also Gelatinerad dynamit.

Svartkrut

BLACK POWDER

For most types of Swedish Black Powder, the composition comes within the following limits: Potassium nitrate 74-78%, charcoal 12-15% & sulfur 10-12%. For different grades of Black Powder, charcoals of different origins & methods of preparation are used. Powders used in shotgun shells contain charcoal from black alder carbonized in furnaces; ordinary powders use charcoal made of birch, alder, willow or linden; and Blasting Powders use pinewood charred in kilns or furnaces.

The present use of Black Powder for military purposes is limited to Ignition Charges, Expelling Charges for shrapnel shells, Bursting Charges for practice shells, Saluting & Blank-fire Charges, time-rings in Fuzes, and in the manufacture of Pyrotechnics & Safety Fuse.

Territ

CHEDDITE
TERRIT

This name is applied to a plastic blasting explosive patented in 1909 by S.A.G. Nauckhoff. It was manufactured since 1910 by the AB Nitroglycerin in Gyttorp. Territ consists of Ammonium Perchlorate 43%, sodium nitrate 28%, liquid Dinitrotoluene/TNT 27.8% & Collodion Cotton 1.2%.

Its properties are as follows: Cartridge density 1.67 gm/cc; velocity of detonation 4700 meters/second; and Trauzl test value 340 cc. Territ is comparable in properties to some low-freezing Dynamites and is safe to handle. Its brisance is such that in blasting coal or other mining operations, no small pieces or dust is formed.

Another formulation consists of Ammonium Perchlorate 43%, Ammonium Nitrate 26% & gelatinized liquid TNT (96% TNT & 4% Nitrocellulose) 31%. Because Territ is sometimes difficult to detonate, present compositions contain Nitroglycerin.

Tetrazen

TETRACENE

Tetracene is a pale-yellow, fluffy, crystalline solid of apparent density 0.5 gm/cc (Lead Azide = 1.8), impact sensitivity with a 2-kg weight 10 cm (Lead Azide = 6 cm) and an explosion temperature of 140°C (Lead Azide = 170°).

Tetracene is used in priming compositions & cover charges for Initiating Agents less easy to ignite. A mixture of Lead Azide & Tetracene is satisfactorily used for charges in explosive rivets. It is also used together with Lead Styphnate as one of the ingredients in the so-called "Sinoxydsatz or Sinoxyd" percussion composition.

See Tetrazen under Swiss Explosives.

Tetryl

TETRYL

Tetryl is obtained as pale-yellow crystals or as a powder of fairly uniform size. In the pure state, it has a melting point of 129.5°C. The technical grade material melts at 128.5-129°C. Tetryl is considered to be the most powerful explosive among the aromatic nitrocompounds. It is also the most sensitive of these compounds; however, it can be pressed into charges without much greater risk than TNT.

Tetryl (cont'd) TETRYL

Because of its high sensitivity to initiation Tetryl is used in Booster Charges. Its high brisance makes it an excellent explosive in Primers. Tetryl is also used in Detonators. Because of its sensitiveness to mechanical shock, 40 cm (TNT >150 mm), Tetryl is not used as a bursting charge in Shells.

Trotyl TNT

TNT is usually produced in flake form having a solidification point of 80.2-80.6°C for the military grade. The industrial grade TNT melts at 76-78°C and a lower grade called liquid TNT or "Tri Oil" is also manufactured in Sweden.

The military grade of TNT is widely used as a bursting charge for high-explosive Shells, Aircraft Bombs, Grenades, Naval Mines, Torpedoes & other ammunition. It is also used in Boosters, Detonators, Land Mines, Demolition Charges & Blasting Explosives. TNT is also used in several composite explosives.

The industrial grade of TNT is used as an ingredient of Dynamites & Mining Explosives.

In conducting the manufacture of TNT by the Bofors-Norell continuous process, a mixture of TNT isomers & Dinitrotoluene is separated as an oily product. This Tri Oil, setting point 35-50°C, is considered an excellent explosive. It is used chiefly as a constituent in plastic explosives of the Dynamite type, and in semi-plastic explosives of the ammonia type. It is also used to some advantage for military purposes in all kinds of ammunition which are not subjected to shock on discharge. By mixing Tri Oil with RDX & adding a small amount of a gelatinizing agent, a powerful high explosive is obtained which is used in Antitank Mines, Aircraft Bombs & some other ammunition.

Unusual Research and Development in the Field of Explosives

"Research in the Transmission of Detonation"

Scientists at the facility of AB Nitroglycerin, Stockholm, have calculated the temperature rise in Nitroglycerin, due to the adiabatic compression of the liquid. They have studied both the low-order & high-order detonation of Nitroglycerin, and have postulated a mechanism of transmission of the detonation wave.

In similar calculations of the adiabatic compression of TNT, the mechanism of both low- & high-order detonation was postulated to be by compression of air and by reaction of the heated surfaces.

The underwater photography of the detonation of spherical TNT has been successfully accomplished by a technique employing an argon flash which is preset to occur after initiation of the TNT. A striking difference in the appearance of low-order & high-order detonation of TNT has been observed.

A low-freezing Dynamite (Nitroglycerin 35%, Ammonium Nitrate 60% & TNT 5%) in cartridges has been found to have two detonation velocities of about 5 & 2 mm/microsecond. If the initiator is a Blasting Cap, the low velocity will result unless the diameter is large. In an investigation carried out by placing a long string of cartridges of 25-mm diameter in polyethylene tubes and initiating them with caps, it was found that low-order detonation always occurred. If, however, the diameter were 35-90 mm, the detonation failed after two or three cartridges had detonated.

Swedish scientists have also demonstrated that it is possible to cause explosives to detonate merely by heating them, provided a certain minimum rate of heat input is maintained.

[Ref: C.H. Johansson et al, Proceedings of the Royal Society 246A, 160-67 (1958) & Chemical Abstracts 52, 21105 (1958)].

Unusual Research and Development in the Field of Explosives (con't)

"Temperature Rise in Ignition by Hot Wires"

The results are given of calculations by a "Besk" computer of the temperature developed in the explosive medium surrounding a wire, the temperature of which is suddenly raised by applying energy. Calculations are made for platinum wires, ranging in diameter from 0.015 to 0.120 mm, surrounded by a composition having the same decomposing properties as those of Mercury Fulminate. An expression is derived for the critical energy per unit length of wire as a function of the square of the wire radius.

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Swiss Explosives

Switzerland is a small country with an area of about 16,000 square miles and a population of about four and one-half million. Since 1474, when independence was proclaimed, Switzerland has not been involved in any wars. However, this country maintains well-trained Armed Forces, and manufactures its own explosives, weapons & ammunition. Switzerland also manufactures several types of commercial explosives of excellent quality.

Production of Black Powder & of Propellants is a government monopoly. There is no commercial production of even sporting powders, with one exception when the Swiss Government authorized the Oerlikon Bürhle Company to manufacture double-base Rocket Propellants for the US Army 8-cm Rockets. The Swiss Government manufactures no military high explosives except small quantities of primary explosives. Reliance is placed upon commercial manufacturers to produce whatever quantities are required by the Swiss Army. However, strict government control is exercised over the production of bulk military high explosives. The commercial manufacturers must obtain both general & specific approval for the production of munitions. Normally, the Swiss Government does not permit the exportation of military high explosives since this commerce would be at variance with the Swiss neutrality policy. However, in the past, TNT in particular has been exported in order to keep certain manufacturing facilities in operation during periods of low Swiss ammunition production.

One of the most prominent explosives specialists of the present day was a Swiss Professor, Dr. Alfred Stettbacher of Zürich, who died in 1961. Some of the information regarding present Swiss explosives was obtained from Dr. Stettbacher, from the Schweizerische Sprengstoff-Fabrik AG & from other Swiss plants.

The principal explosives known to be used or manufactured in Switzerland are listed alphabetically in the following pages.

Aldorfit

ALDORFIT
AMMONIUM NITRATE DYNAMITE

This safety explosive was developed, and is currently manufactured by the Schweizerische Sprengstoff-Fabrik AG, Dottikon, Switzerland.

See under German Explosives and also Gelatine-Aldordit.

Amidogène

AMIDOGÈNE
BLACK POWDER

This is a Black Powder-type explosive consisting of potassium nitrate 73%, charcoal or similar materials 8%, bran or starch 8%, sulfur 10% & magnesium sulfate 1%.

Ammonpentrinit

AMMONPENTRINIT

This name is applied to a series of PETN/Nitroglycerin explosives in which Ammonium Nitrate is incorporated in order to make them suitable for blasting purposes. Some compositions invented by Dr. A. Stettbacher are as follows:

a) PETN 40.9%, Nitroglycerin 40.9%, Collodion Cotton 1.6% & Ammonium Nitrate 16.6%.

b) PETN 40.6%, Nitroglycerin 7.6%, Nitroglycol 2.6%, Ammonium Nitrate 47.5% & vaseline 1.7%.

c) PETN 37%, Nitroglycerin 7.2%, Nitroglycol 2%, Collodion Cotton 0.8%, liquid Dinitrotoluene 5% & Ammonium Nitrate 48%. Its loading density is 1.37 gm/cc (maximum density = 1.45); velocity of detonation 6600 meters/second; and gas volume 430 liters/kg.

d) PETN 31%, Nitroglycerin 7.5%, Collodion Cotton 0.5%, Ammonium Nitrate 59% & vaseline 2%.

e) PETN 33.8%, Nitroglycerin 50.7%, Collodion Cotton 2.5% & Ammonium Nitrate 13%.

See also Gelatine-Pentrinit and Pentrinit.

Bleitrinitroresorcinat or Bleistyphnat — LEAD STYPHNATE

This compound, consisting of deep-orange crystals of density 3.1 gm/cc, was prepared by adding aqueous sodium carbonate to a boiling aqueous solution of Styphnic Acid, followed by adding lead nitrate.

It is used as an Initiating Explosive. See under German Explosives.

Brandbomben & Brandstoffe — INCENDIARY BOMBS & COMPOSITIONS

Considerable work in the development & study of Incendiary Explosives has been reported in the literature by Dr. A. Stettbacher.

The latest improved Napalm Incendiary Bomb was manufactured & demonstrated by the Holzverzuckerungs Aktiengesellschaft (AG), Domat-Ems (Graubünden). Napalm consisted of an intimate mixture of metallic aluminum or sodium with heavy petroleum or "Mazut", which replaced lignin occurring as the by-product in wood hydrolysis.

Cellulosenitrat, Nitrocellulose or Nitrozellulose — NITROCELLULOSE

Cyanurtriazid — CYANURIC TRIAZIDE

It was patented in 1921 by the Chemische Industrie Basel for use in Detonators.

Detonatoren- und Sprengkapseln-Ladungen — DETONATOR AND BLASTING CAP CHARGES

See under German Explosives.

Detonierende Zündschnur or Knallzündschnur — DETONATING FUSE PRIMACORD

A general description of various Swiss Detonating Fuses is given by A. Stettbacher, "Schiess- und Sprengstoffe", Leipzig (1933),

Detonierende Zündschnur (cont'd)

358-59, and "Spreng- und Schiesstoffe", Zürich (1948), 107 (Fulminatschnur & Pentritschnur)

The Société Suisse des Explosifs, Gamsen-Brigue, [Swiss Patent 230077 (1944) & Chemical Abstracts 43, 2438 (1949)] patented a Detonating Fuse comprised of a core of PETN or RDX in a gel of Collodion Cotton & a liquid explosive such as Nitroglycerin, Nitroglycol or Tetranitroisobutylglycerin. This composition is coated on several textile threads and covered with a fabric coating instead of lead. The core explosive is insensitive to moisture. The propagation velocity of this Detonating Fuse with PETN is reported, in a private communication from Dr. Stettbacher, to be 7000 meters/second.

Dynamit DYNAMITE

The compositions of Swiss Dynamites are, in general, similar to those manufactured in German. The Swiss plants manufacturing Dynamites include:

1. Schweizerische Sprengstoff-Fabrik AG Cheddit & Dynamit at Liestal and Isleten: Blasting Gelatin (Sprenggelatine) with or without Nitroglycol, and Safety Explosives such as Gelatine-Cheddit & Telsit.

2. Schweizerische Sprengstoff-Fabrik AG at Dottikon (Aargau): Dynamit F & others of various strengths, and Safety Dynamites Aldorfit & Gelatine-Aldorfit.

3. Société Suisse des Explosifs at Gamsen-Brigue: Blasting Gelatine and Safety Dynamites such as Gamsit & Gelatine-Aldorfit.

The Swiss Dynamit F is similar in composition to German Dynamit 1, except that only Ammonium Nitrate is used as the oxidizer, and no vegetable meal is used because a better fuel is available. This fuel is carbene or cuprene, a polymerized acetylene product.

Gamsit or Gelatine-Gamsit — GELATIN DYNAMITE GAMSIT

This is a class of Dynamites successfully used in blasting some tunnels thru the Alps. Their compositions are reported as: a. Ammonium Nitrate 60%, Nitroglycerin 21%, Nitroglycol 5%, Collodion Cotton 1.6%, liquid Dinitrotoluene 12% & wood meal 0.4% and b. Ammonium Nitrate 63.5%, Nitroglycerin (or its mixture with Nitroglycol) 22%, Collodion Cotton 1.5% & liquid Dinitrotoluene and TNT 13%. This latter composition, also called Gamsit A, appears to be identical to Gelatine-Aldorfit A & Telsit. Both of these explosives have the same Trauzl test value for a 10 gram sample, 433 cc vs 311 cc for TNT at density 1.55.

There are also explosives designated Gamsit B (Trauzl test value 378 cc) & Gamsit C (Trauzl test value 333 cc), but their compositions are not reported.

See also Simplonit & Telsit.

Gelatine-Aldorfit — GELATIN DYNAMITE

This is a class of plastic Dynamites containing Nitroglycerin. Gelatine-Aldorfit A is identical in composition to Gamsit A. Its properties are reported as follows: Density in cartridge 1.49 gm/cc; velocity of detonation 6000 meters/second; impact sensitivity with a 5-kg hammer 35 cm vs 45 cm for TNT; explosion temperature 185°C (rate of heating 20°C/minute); Trauzl test value 400 cc; and brisance by copper cylinder method 3.25 mm vs 2.86 mm for TNT.

Other plastic Dynamites are designated Gelatine-Aldorfit B, Gelatine-Aldorfit C & Gelatine-Aldorfit with 20% aluminum, but their compositions are not reported.

These explosives are used in tunnel blasting & in general blasting operations.

Gelatine-Cheddit — GELATIN DYNAMITE

This is a plastic chlorate explosive invented in 1911 by C. Rubin at Liestal. It is now manufactured by the Schweizerische-Sprengstoff-Fabrik AG Cheddit & Dynamit. The composition is as follows: Sodium Chlorate 79%, coated with a liquid mixture of castor oil 5%, liquid Dinitrotoluene 2% & TNT 14% preheated to 40°C. Some Collodion Cotton may also be incorporated into the mixture.

Gelatine-Cheddit (cont'd)

The properties of this explosive are: Loading density 1.85 gm/cc (maximum density 1.97); velocity of detonation 3800 meters/second; impact sensitivity with 2-kg hammer 50 cm (TNT = 90 cm & Picric Acid = 60 cm); Trauzl test value 257 cc (TNT = 311 cc at density 1.55); volume of gases at NTP 340 liters/kg; heat of explosion at constant volume (water vapor 1100 cal/gm or 2035 kcal/liter); and temperature developed on explosion 3500°C. This explosive is stable and does not harden in storage.

Gelatine-Dynamit — GELATIN DYNAMITE

The composition & properties of Swiss Gelatin Dynamites are essentially the same as those used in Germany.

See Gelatinedynamit under German Explosives.

Gelatine-Gamsit — GELATIN DYNAMITE

See Gamsit.

Gelatine-Pentrinit — GELATINE PENTRINIT

This name is applied to a series of PETN/Nitroglycerin explosives in which Collodion Cotton is incorporated in order to make the mixture more plastic and to prevent exudation. Some compositions developed by Dr. A. Stettbacher are as follows:

a) PETN 50%, Nitroglycerin 46% & Collodion Cotton 4%. Its loading density is 1.57 gm/cc (maximum density 1.68); velocity of detonation 8000 meters/second; impact sensitivity with a 2-kg hammer 17 cm; heat of explosion (water vapor) 1549 cal/gm; volume of gases at NTP 744 liters/kg; and temperature developed on explosion 4750°C.

b) PETN 59%, Nitroglycerin 24.7%, Collodion Cotton 0.6% & Ammonium Perchlorate 15.7%.

c) PETN 15.5%, Nitroglycerin 77.5% & Collodion Cotton 7%.

d) PETN 38.4%, Nitroglycerin 35.4%, Collodion Cotton 3% & aluminum 23.2%. This composition is prepared by adding 30% of aluminum to mixture a. above. Its loading density is 1.85 gm/cc (maximum density 1.96); velocity of detonation 7200 meters/second; heat of explosion (water vapor) 2278 cal/gm; and volume of gases at NTP 520 liters/kg.

Gelatine-Pentrinit (cont'd)

Other compositions & uses are given under Ammonpentrinit and Pentrinit.

Gelatine-Telsit — TELSIT

See Telsit.

Hexogen — RDX

This explosive has been prepared & studied in Switzerland only on a laboratory basis and for research purposes.

Hexonit — HEXONIT

This is a plastic explosive proposed by Dr. A. Stettbacher. Its composition consists of: a) RDX 20-50% & Nitroglycerin 80-50%; b) RDX 50%, Nitroglycerin 46% & Collodion Cotton 4%.

Comparative brisance tests of 50/50 Hexonit and 50/50 Pentrinit by the iron plate test show that Hexonit is not as effective as Pentrinit. Stettbacher claims that RDX does not form as homogeneous a mass with Nitroglycerin & Nitrocellulose as does PETN.

Holtex — HOLTEX

Holtex is a grey-black, hard rubber-like explosive invented by the German explosives chemist Dr. Erich von Holt, who unfortunately lost his life in an accident on 12 July 1962. In general, Holtex is described as a gelatinized Explosive or Propellant consisting of Nitroglycerin, Nitrocellulose & PETN to which water-insoluble metal soaps are added to gelatinize, homogenize & stabilize it.

This explosive was developed by Hispano Suiza SA, Genève, and is manufactured in different compositions for use as brisant explosives & as Propellants. German Patent DBP (Deutsches Bundes Patent) 1031700 (August 1962) lists the following examples as brisant explosives of high performance levels:

Holtex (cont'd)

a) Nitrocellulose 54%, Nitroglycerin 16%, TNT 18%, PETN 8% & water insoluble metal soaps (70% magnesium oleate, 20% calcium oleate & 10% calcium stearate) 4%.

b) Nitrocellulose 40%, Nitroglycerin 36%, PETN 17.5%, Nitroguanidine 3.5% & calcium oleate 3%.

c) Nitrocellulose 45%, Nitroglycerin or Diethyleneglycol Dinitrate 33%, PETN 9%, Ammonium or Calcium Perchlorate 10% & calcium oleate 3%.

d) Nitrocellulose 46.5%, Nitroglycerin or Diethyleneglycol Dinitrate 33.5%, PETN or RDX 16% & water insoluble metal soaps (88% calcium oleate, 10% magnesium oleate & 2% aluminum oleate) 4%.

e) Nitrocellulose 8%, Nitroglycerin 12%, TNT 20%, aluminum & barium nitrate 48% & water insoluble metal soaps 12%.

Capt K. Böhlein in Explosivstoffe 1962, pages 156-58, describes a Holtex explosive (composition not specified) and reports some of its properties as follows: Density 1.63 gm/cc; velocity of detonation 8000 meters/second; heat of explosion 1230 cal/gm; specific gas volume 860 cc; temperature developed on explosion 3650°K; specific energy 11,900 (calculated by formula of Abel); Trauzl test value 450 cc; copper cylinder compression test 4.9 mm; impact sensitivity with 2-kg hammer 120 cm; insensitive to rifle bullet impact; and of satisfactory stability as determined by Hansen test at 110°C.

Holtex can be shaped into any desired form by the usual process of hot rolling the powder, without any solvent, and molding or extruding in conventional equipment. A flexible form of Holtex which can be used as circumferential charges in the form of long ropes is also reported. The finished product in any form requires no packaging for handling or use. It can also be machined or fabricated on a lathe.

Holtex is initiated by a No. 8 Cap and can be detonated in layers only 1-mm thick. It is used as a high brisance explosive, as a Demolition Charge in Mines, and as a Propellant.

It is reported that tests on Holtex are being conducted at the German Schlebusch facility of the Federal Bureau for Material Testing (Bundesanstalt für Material Prüfung Berlin Ausstelle Schlebusch).

See also Nipolit (invented by Dr. von Holt) under German Explosives.

Initialexplosivstoffe & Zündsprengstoffe | INITIATING AND PRIMING EXPLOSIVES

A considerable amount of work on the preparation & determination of the properties of Initiating & Priming Explosives has been published by Dr. A. Stettbacher in the literature. These studies include such explosives as Bleitrinitroresorcinat (Lead Styphnate), Bleiazid (Lead Azide), Silberazetylenid (Silver Acetylide), and Silberazid (Silver Azide).

According to Stettbacher, the latest inovation in Initiating Explosives is the use of colloidal graphite in compositions intended to be initiated by electrical ignition.

See also under German Explosives.

Knallzündschnur | PRIMACORD

See Detonierende Zündschnur.

Kollodiumwolle (Collodion Cotton) | NITROCELLULOSE

Swiss Collodion Cotton for use in Sprenggelatine & Gelatine-Dynamit is manufactured at the Swiss plant Die Eidgenössische (Staatliche) Pulverfabrik at Wimmis (Bern).

Nitrocellulose, Nitrozellulose or Cellulosenitrat | NITROCELLULOSE

Nitrogelatinedynamit | GELATIN DYNAMITE

Dynamites by this name are those containing 20-25% Nitroglycerin (or its low-freezing mixture of 4/1 with Nitroglycol) gelatinized with Collodion Cotton, Ammonium Nitrate & a liquid aromatic nitrocompound (such as drip oil which is a mixture of crude Dinitrotoluene & TNT, called "Flüssiges Tri"), serving as a phlegmatizer.

Some explosives of this type which belong to the class of Sicherheitsdynamite (safe to handle & transport) include Aldorfit, Gamsit & Telsit.

Nitroglycerin or Nitroglyzerin — NITROGLYCERIN

Nitroglycerin is manufactured in Switzerland by the continuous methods of Schmid-Meissner and of Biazzi, which are preferred to batch processes. The Schmid-Meissner process is described (in German & in English) in Explosivstoffe 1957, 65-74. The Biazzi process is described by H.J. Klassen & J.M. Humphreys, Chemical Engineering Progress 49, 641-46 (1953) and by A. Stettbacher, Explosivstoffe 1959, 187-93 & 206-10.

Nitroglycerin for military uses is manufactured by Biazzi method at plants located in Iseleten & Wimmis, and by Schmid-Meissner method at Gamsen. Other plants which manufacture Dynamites also make Nitroglycerin for nonmilitary commercial uses.

Nitropentaerythrit — PETN

See Pentaerythrit-tetranitrat.

Nizol — NIZOL

A high explosive consisting of TNT 50% & Dinitrobenzene 50% was patented by Schweizerische Sprengstoff-Fabrik AG, Dottikon. Its properties are not given.

Oxypikrinsäure — STYPHNIC ACID

See Trinitroresorzin.

Pentaerythrit-tetranitrat, Nitropentaerythrit or Pentrit — PETN

The possibilities of using PETN in both military & civilian explosives were realized by Dr. A. Stettbacher as early as 1916. At present, PETN is manufactured at the Schweizerische Sprengstoff-Fabrik AG, Dottikon, by nitrating with fuming nitric acid (density 1.52 gm/cc) at 25°C technically pure pentaerythritol (called penta & abbreviated PE in Switzerland). The product is purified by crystallizing it from acetone. Its melting point is 142°C and crystal density 1.77 gm/cc.

PETN is phlegmatized (desensitized) when used in military composite explosives. See Swiss Patent 226852 (1953) & Chemical Abstracts 43, 2438 (1949).

Pentastit

PENTASTIT

This is a trade name for military explosives prepared by phlegmatizing PETN with pentaerythritol tetrastearate (called pentaerythrit-tetrastearat in German). These explosives are manufactured by the Schweizerische Sprengstoff-Fabrik AG at Dottikon, Switzerland.

The properties & compositions of some Pentastit explosives with & without aluminum are reported as follows:

	93/7 Pentastit		96.5/3.5 Pentastit	
	100%	20% Al	100%	20% Al
Melting point, °C	137	137	138	138
Explosion temp (20°C/minute), °C	192	190	198	198
Impact sensitivity, 5 kg hammer, cm	30	29	23	22
Density, gm/cc	1.56	1.68	1.60	1.67
Velocity of detonation, méters/second	8000	7700	8100	7700
Trauzl test value, cc/10 gm sample	408	467	420	512
Copper cylinder compression test, mm	3.50	3.34	3.63	3.36

The above information is reported by Dr. A. Stettbacher, "Spreng- und Schiesstoffe" (1948), page 122, and by private communication (December 1953).

See also Swiss Patent 220756 (1942) & Chemical Abstracts 42, 6538 (1948).

Pentrinit

PENTRINIT

Pentrinits are plastic, non-exuding explosive mixtures of PETN & Nitroglycerin. They were invented in 1928-29 by Dr. A. Stettbacher of Zürich, Switzerland. One of the first mixtures consisted of PETN 80% & Nitroglycerin 20%. It was considered suitable as a bursting charge in Shells; and as the base charge, with Lead Azide as the primary charge, in Detonators. Another mixture consisting of PETN 85% & Nitroglycerin 15% was tested in Italy by I. Izzo in 1933 and found to be stable after storage for 28 months.

Pentrinit (cont'd)

The above & other Pentrinits developed by Dr. Stettbacher are as follows:

a) PETN 80% & Nitroglycerin 20%. Loading density 1.49 gm/cc (maximum density 1.72); velocity of detonation 8600 meters/second; Trauzl test value 530 cc; impact test value with 2-kg hammer 29 cm; heat of explosion (water vapor) 1450 cal/gm; and volume of gases at NTP 762 liters/kg.

b) PETN 85% & Nitroglycerin 15%. Heat of explosion (water vapor) 1438 cal/gm; and volume of gases at NTP 766 liters/kg.

c) PETN 70% & Nitroglycerin 30%. Loading density 1.50 gm/cc (maximum density 1.71); velocity of detonation 8500 meters/second; Trauzl test value 510 cc; lead block compression test value 29 mm; and heat of explosion 1473 cal/gm.

d) PETN 50% & Nitroglycerin 50%. Maximum density 1.68 gm/cc; velocity of detonation 8400 meters/second; and heat of explosion (water vapor) 1551 cal/gm.

e) PETN 40% & Nitroglycerin 60%. Maximum density 1.67 gm/cc; velocity of detonation 8200 meters/second; and heat of explosion (water vapor) 1542 cal/gm.

f) PETN 80%, Nitroglycerin 15% & Nitroglycol 5%. Maximum density 1.71 gm/cc; velocity of detonation 8600 meters/second; Trauzl test value 528 cc; and heat of explosion (water vapor) 1447 cal/gm.

It should be noted that the amount of Nitroglycerin in Pentrinit may be as high as 60% of the mixture. However, in order to improve the plasticity and to prevent exudation in this and other Pentrinits with lower Nitroglycerin contents, it is recommended to incorporate some Collodion Cotton (up to 6%) in the composition. Such explosives are called Gelatine-Pentrinits (qv). If less brisant explosives are desired, some Ammonium Nitrate (up to 50%) may be incorporated. These explosives are called Ammonpentrinits (qv).

Low-freezing Pentrinits were prepared, before WW II, for research purposes at the Gamsen-Brigue plant by mixing the Nitroglycerin used with 20-25% of Nitroglycol. Such a composition proved to be a very effective explosive.

Pentrinit (cont'd)

Pentrinits are reported to be particularly suitable as bursting charges in underwater ammunition. The addition of up to 15% aluminum increases the efficiency of Pentrinit in this application.

Pentrit — PETN

See Pentaerythrit-tetranitrat.

Pentro or Pentryl — PENTOLITE

These are trade names for explosives consisting of mixtures of PETN & TNT in various proportions. They are prepared by dissolving PETN & TNT in acetone and precipitating the product by adding water. Pentro explosives are manufactured by the Schweizerische Sprengstoff-Fabrik AG, Dottikon.

The properties & compositions of some Pentro explosives with & without aluminum are reported as follows:

	70/30 Pentryl		60/40 Pentryl		50/50 Pentryl	
	100%	15% Al	100%	15% Al	100%	15% Al
Melting point, ^{o}C	70-130	70-130	70-125	70-125	70-120	70-120
Explosion temp ($20^{o}C$/minute), ^{o}C	202	202	200	200	200	190
Impact sensitivity, 5-kg hammer, cm	23	22	24	22	25	24
Density, gm/cc	1.58	1.65	1.56	1.68	1.55	1.62
Velocity of detonation, meters/second	7800	7400	7600	7200	7450	7000
Trauzl test value, cc/10-gm sample	394	498	370	490	362	450
Copper cylinder compression test, mm	3.48	3.49	3.39	3.38	3.24	3.38

Dr. A. Stettbacher reports in a private communication that 50/50 Pentryl was used as the main charge in Oerlikon 20-mm Cannon (Oerlikoner 2-cm Kanone) Shells.

Pierrit — CHEDDITE

This is a blasting explosive consisting of Potassium Chlorate 80%, mononitrotoluene 12%, Picric Acid 2% & castor oil 6%. Large

Pierrit (cont'd)

quantities of this explosive were manufactured at the Gamsen-Brigue plant for use during construction of the Simplon & other tunnels in Switzerland.

Plastit — PLASTIT

This is a trade name plastic military explosive based on PETN. It is manufactured by the Schweizerische Sprengstoff-Fabrik AG, Dottikon, but its composition is not reported.

Plastolit — PLASTOLIT, DYNAMITE

This is a plastic safety explosive consisting of sodium nitrate 57%, Nitroglycerin 15%, Nitroglycol 4%, Collodion Cotton 1.3%, liquid Dinitrotoluene 13%, cellulose (wood meal) 9.6% & sodium bicarbonate 0.1%.

It was used for general blasting operations.

Sicherheitssprengstoffe (Safety Explosives) — DYNAMITE

Many Swiss commercial explosives belong to this class of Dynamites. See Aldorfit, Gamsit & Telsit.

See also under German Explosives.

Simplonit — DYNAMITE, SIMPLONIT

This is a Dynamite composition consisting essentially of Gamsit in which 10-15% aluminum powder has been added. Its Trauzl test value is reported as 340 cc for Simplonit A, pulvrig and 299 cc for Simplonit B, pulvrig (no composition is given). Simplonit is manufactured by the Société Suisse des Explosifs, Gamsen-Brigue.

See also Gamsit.

Spezialsprenggelatine — BLASTING GELATIN

This name was given by Dr. Stettbacher to low-freezing Dynamites based on Blasting Gelatin, in which part of the Nitroglycerin was replaced by aromatic nitrocompounds. Such Dynamites were manufactured at Iseleten and used in the construction of Jungfrau & other tunnels in Switzerland.

See also Dynamit.

Styphninsäure — STYPHNIC ACID

See Trinitroresorzin.

Telsit — GELATIN DYNAMITE TELSIT

This name is applied to a series of Nitrogelatin Dynamites manufactured by the Schweizerische Sprengstoff-Fabrik AG Cheddit & Dynamite at Isleten. The compositions & properties of Telsit Dynamites are as follows:

Telsit. Composition is the same as Gamsit A. Its properties are reported under Gelatine-Aldorfit which has the same composition.

Telsit-Gamsit. Same as Gamsit or Gelatine-Gamsit, containing 60% Ammonium Nitrate.

Gelatine-Telsit. Ammonium Nitrate 55.5%, Nitroglycerin 22%, Collodion Cotton 1.5% & Dinitrotoluene 21%. Its oxygen balance is -13%; density 1.46 gm/cc; velocity of detonation 6700 meters/second; Trauzl test value 380 cc; lead block compression value [illegible]4.6 mm; and requires a No 6 Cap for its detonation.

Telsit was used extensively for tunnel blasting in the Alps.

Tetrazen — TETRACENE

This compound is prepared by the diazotization of aminoguanidine bicarbonate. The product consisting of pale-yellow crystals is insoluble in any known solvent. Tetracene leaves no residue when it detonates, but due to its slow build-up of detonation it cannot be used alone as an initiating agent. It is used in admixtures with so-called fast-igniting agents. One priming composition called

Tetrazen (cont'd)

Sinoxydsatz or Sinoxyd was developed in Germany before WW II. It consisted of Lead Styphnate 25-55%, barium nitrate 25-45%, lead peroxide 5-10%, Tetracene 1.2-5%, antimony trisulfide 0-10%, calcium silicide 3-15% & powdered glass 0-5%.. It is claimed that this mixture is noncorrosive and does not erode the barrel of weapons.

Tetranitromethylanilin or Tetryl — TETRYL

Tetryl was manufactured as a military explosive by the Schweizerische Sprengstoff-Fabrik AG, Dottikon. The technically pure product has a melting point of 127-127.5°C.

Thermitzündung (Thermite, Priming & Igniting) — THERMITE

Because some insensitive explosives (those containing Ammonium Nitrate) are difficult to detonate when confined in Bombs or Shells, Stettbacher & Billwiller conceived the idea of using Thermite as a priming agent. It was assumed that due to the high temperature developed by Thermite (2400°C), both the Ammonium Nitrate & the combustible material would decompose into gases which form an explosive mixture. Further heating would create sufficient gas pressure to cause detonation. It was found that Thermite priming works only when the explosive loading density is 1.25 gm/cc or lower. When explosives of higher densities (1.50-1.60 gm/cc) are initiated by Thermite, only decomposition, not detonation, occurs.

Totalit — TOTALIT

This explosive composition, consisting of Ammonium Nitrate 95.5% & paraffin (melting point 54-56°C) 4.5%, was developed as a military bursting charge. Its properties are reported as follows: Volume of gases at NTP 972 liters/kg; heat of explosion at constant volume (water vapor) 1163 cal/gm; temperature developed on explosion 3105°C; specific pressure (force f) 12021; and brisance value by Kast formula 50×10^6 at density 1.60 gm/cc (TNT = 86×10^6).

Trinitroanisol or Trisol — TRINITROANISOLE

Trinitroanisole was manufactured as a military explosive by the Schweizerische Sprengstoff-Fabrik AG, Dottikon.

Trinitroresorzin, Styphninsäure or Oxypikrinsäure — STYPHNIC ACID

This compound was manufactured during WW II for military purposes by The Schweizerische Sprengstoff-Fabrik AG, Dottikon.

Trinitrotoluol or Trotyl — TNT

TNT was manufactured during WW II by a two-stage process, first to mononitrotoluene and then directly to TNT. The crude product is called "Rohtri", melting point 76-78°C; and the purified TNT is called "Reintri", melting point 80-81°C. There are several methods used to purify TNT, such as by sodium sulfite solution or by recrystallization from nitric acid. In the opinion of Dr. A. Stettbacher, the best method (but more expensive) of purifying TNT is to recrystallize it from hot acetone containing 8% of benzene. This method is used at the Schweizerische Sprengstoffe-Fabrik AG, Dottikon, and in Holland, for the purification of TNT used as a bursting charge in HE Projectiles.

The TNT used in commercial explosives, such as Aldorfit, does not need to be of high purity and sometimes it is advantageous to use the so-called "Flussige Tri" (liquid TNT). The "Dottikoner Flussig Tri" consists of 60% TNT (called "Tri") & 40% Dinitrotoluene (called "Di"). Its nitrogen content is 17.24%.

Straight TNT is used for cast loading various military Projectiles. Pressed TNT is used as an insertion charge in Detonators in order to facilitate the initiation of cast TNT. There are also several composite explosives using mixtures of TNT & PETN (such as (Pentro or Pentryl) and TNT & other high explosives as military bursting charges.

Unknown Name Explosives — SWISS UNKNOWN NAME EXPLOSIVES
(Designations are given only for convenience)

Ammonium Nitrate Explosive:
A fusible explosive consisting of Ammonium Nitrate 70%, PETN 10%, TNT 10% & sodium ammonium phosphate ($NaNH_4HPO_4 \cdot 4H_2O$) 10%. Even a small

Unknown Name Explosives (cont'd)

Ammonium Nitrate Explosive (cont'd):
amount of the phosphate causes the mixture to have a low melting point and also gives the mixture a high degree of stability. This particular phosphate tends to decompose slightly at its melting point (dec 79°C) to form monosodium orthophosphate which neutralizes any alkalinity in the explosive. [Société Suisse des Explosifs, Swiss Patent 228940 (1943) & Chemical Abstracts 43, 2437 (1949)].

Matter's Explosives:

a) A plastic dynamite consists of tar distillates mixed with inorganic oxidizers such as nitrates, chlorates or perchlorates. [O. Matter, Swiss Patent 220755 (1942) & Chemical Abstracts 42, 6538 (1948)].

b) An explosive composition is prepared from mixtures of inorganic oxidizers (nitrates, chlorates or perchlorates), a water-insoluble hydrocarbon (chloronaphthalene), and a resinous thickening agent (rosin or tar-distillation residue). [O. Matter, Swiss Patent 228653 (1943) & Chemical Abstracts 43, 2437 (1949)].

c) Black Powder substitute or Priming Composition. A valuable carbonaceous material, free from inorganic matter and suitable for use in Black Powder or Priming Compositions, is prepared by extracting coal with high-boiling organic solvents such as coal-tar oils, followed by filtration & distillation to remove the solvent. The quality of the product can be improved by further extraction with acetone, carbon disulfide, or chloroform. [O. Matter, Swiss Patent 244352 (1946) & Chemical Abstracts 43, 4468 (1949)].

Tetranitromethane-Hydrocarbon Explosives:

Mixtures of Tetranitromethane & hydrocarbons are among the most brisant & powerful explosives known. The properties of these mixtures were studied & reported by Dr. A. Stettbacher, Nitrocellulose 13, 14 (1942); Zeitschrift für das gesamte Schiess- und

Unknown Name Explosives (cont'd)

Tetranitromethane-Hydrocarbon Explosives (cont'd)

Sprengstoffwesen 37, 42-45 & 62-64 (1942); and "Spreng- und Schiesstoffe", Rascher, Zürich (1948), pages 10, 16 & 148.

Vergé Explosivstoffe — DYNAMITE · VERGÉ EXPLOSIVSTOFFE

Vergé patented, before WW I, low-freezing explosives based on mixtures of Nitroglycerin, Collodion Cotton, perchlorates (or nitrates) & liquid aromatic nitrocompounds (mixtures of Dinitrotoluene & crude TNT). Some examples of these compositions are as follows:

a) Nitroglycerin 40%, Guncotton 5%, Ammonium Perchlorate 38%, & liquid nitrocompounds 17%. Its oxygen balance is -5.4%.

b) Nitroglycerin 37%, Guncotton 4.5%, Ammonium Perchlorate 25.2%, sodium nitrate 18.3%, & liquid nitrocompounds 15%. Its oxygen balance is +1.1%.

c) Nitroglycerin 38%, Collodion Cotton 2%, Ammonium Perchlorate 26%, sodium nitrate 18% & liquid nitrocompounds 16%. Its oxygen balance is +1.0%; density 1.52 gm/cc; velocity of detonation 6600 meters/second; Trauzl test value 450 cc; lead block crushing value 20.6 mm; sensitivity to initiation, No 1 Cap required; and propagation in 25-mm Cartridges (open air) 40 mm.

d) Nitroglycerin 41%, Collodion Cotton 3%, Potassium Perchlorate 38% & liquid nitrocompounds 18%. Its oxygen balance is -1.1%; density 1.57 gm/cc; velocity of detonation 7300 meters/second; Trauzl test value 405 cc; lead block crushing value 18.2 mm; sensitivity to initiation, No. 1 Cap required; and propagation in 25-mm Cartridges (open air) 40 mm.

Zündsprengstoffe & Initialexplosivstoffe — PRIMING AND INITIATING EXPLOSIVES

See Initialexplosivstoffe.

Unusual Research & Development in the Field of Explosives

"The Basic Azides of Lead Azide and the Hydrolysis of Lead Azide"

Professors W. Feitknecht & M. Sahli of the University of Bern, Switzerland, claim to have found nine (9) different forms of basic Lead Azide by hydrolysis of Lead Azide at low temperature. Work on high-temperature hydrolysis of Lead Azide accomplished in the USA reveals only two phases. The preparation & identification of the different phases of Lead Azide by X-ray diagrams are reported in detail in the published work.

Interest in the hydrolysis of Lead Azide at room temperature is based on the possibility of accidental explosions of Detonators containing copper, which reacts with Hydrazoic Acid to form Copper Azide.

[Ref: W. Feitknecht & M. Sahli, Helvetica Chimica Acta 37, 1423-36 (1954) & Chemical Abstracts 48, 13505-06 (1954)].

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